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TRANSACTIONS

OF THE

ASSOCIATION OF AMERICAN PHYSICIANS.

FOURTH SESSION,

HELD AT WASHINGTON, D. C.,

SEPTEMBER 18, 19, AND 20, 1889.

VOLUME IV.

PHILADELPHIA:
PRINTED FOR THE ASSOCIATION.
1889.

NOTICE.

THIS volume of TRANSACTIONS contains the papers read before the Association at the meeting held September 18, 19, and 20, 1889.

The Association assumes no responsibility for the statements and opinions published in this volume.

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PHILADELPHIA.

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1886. METCALFE, JOHN T., M.D., New York.
1886. STILLÉ, ALFRED, M.D., 3900 Spruce St., Philadelphia.

MINUTES

OF THE

FOURTH ANNUAL MEETING

OF THE

ASSOCIATION OF AMERICAN PHYSICIANS,

Held in the Army Medical Museum and Library Building, Washington, D. C.

The following members were present:

From Philadelphia: Drs. Henry F. Formad, I Minis Hays, Frederick P. Henry, James H. Hutchinson, Morris J. Lewis, Arthur V. Meigs, S. Weir-Mitchell, John H. Musser, William Pepper, Wharton Sinkler.

From Baltimore: Drs. I. E. Atkinson, W. T. Councilman, F. T. Miles, William Osler, George M. Sternberg, William H. Welch.

From Boston: Drs. Charles F. Folsom, George M. Garland, Francis Minot, James J. Putnam, George B. Shattuck.

From Washington: Drs. John S. Billings, Samuel C. Busey, Robert T. Edes, W. W. Johnston, D. W. Prentiss.

From New York: Drs. A. Brayton Ball, A. Jacobi, Francis P. Kinnicutt.

From St. Louis: Drs. G. Baumgarten, P. G. Robinson.

From Albany: Dr. Henry Hun.

From Chicago: Dr. Hosmer A. Johnson.

From Jamaica Plain: Dr. Harold C. Ernst.

From Montreal: Dr. James Stewart.

From Pittsfield: Dr. J. F. A. Adams.

From Portland: Dr. Israel T. Dana.

From Pottsville: Dr. John T. Carpenter.

SEPTEMBER 18, 1889.—MORNING SESSION.

PRESIDENT FRANCIS MINOT called the meeting to order at 10.30 A. M., and delivered the "Inaugural Address."

On motion of Dr. Hays, the reading of the Minutes of the last meeting was omitted, and they were accepted as printed in volume third of the *Transactions*.

Dr. W. W. Johnston read his report as Treasurer, which was accepted, and Drs. Ball and Edes were appointed an Auditing Committee.

The Secretary read a circular letter of invitation to the International Medical Congress, to be held in Berlin, in 1890; and also announced the resignation of Dr. F. W. Draper as a member of the Association.

The Amendments to the Constitution introduced at the last meeting were taken from the table, and on motion of Dr. Pepper, it was resolved that Article V. of the Constitution be amended by striking out the word "ten" and inserting in place of it the word "fifteen." On motion of Dr. Pepper, it was resolved that an article be inserted in the Constitution to read as follows: "The Representative on the Executive Committee of the Congress of American Physicians and Surgeons shall have full power to represent the Association on all ordinary questions, but must be authorized by the Council of this Association before assenting to the admission of any Society to the Congress."

On behalf of the Council, the Secretary introduced the following revised constitution as an amendment to the present one, which revised constitution would come up for action at the next meeting.

ARTICLE I.

Object and Name.

This Association has for its object the advancement of scientific and practical medicine, and shall be known as THE ASSOCIATION OF AMERICAN PHYSICIANS.

ARTICLE II.

Members.

The number of active members shall be limited to one hundred. Physicians of sufficient eminence to merit the distinction may, to a

number not exceeding twenty-five, be elected honorary members, and as such shall be entitled to attend all meetings and to take part in the proceedings, but not to vote.

Membership shall lapse by reason of absence from three successive meetings without reason given acceptable to the Council. Membership may be forfeited for reasons deemed sufficient by the Association.

Article III.

Officers.

The Officers of the Association shall be a President, a Vice-President, a Secretary, a Recorder, a Treasurer—all to be elected annually; five Councillors, one to be elected each year for a term of five years; and a Representative to serve on the Executive Committee of the Congress of American Physicians and Surgeons, to be elected at the annual meeting immediately following the Congress.

Article IV.

Duty of Officers.

The duties of the President, Vice-President, Secretary and Treasurer, shall be those usually assigned to these officers. The Recorder shall secure the papers read and also proper notes of the discussions thereon, and shall publish the annual volume of Transactions. The five Councillors shall constitute a Committee of Nomination of Officers, and as such shall present a report at the commencement of the morning session of the last day of the annual meeting, at the conclusion of which session the election shall be held by ballot. The Representative on the Executive Committee of the Congress shall have full power to represent the Association on all ordinary questions, but must be authorized by the Council of this Association before assenting to the admission of any Society to the Congress.

Article V.

Council.

The officers of the Association shall constitute the Council, of which four members shall constitute a quorum. It shall be the duty of the Council to make all the arrangements for the annual meeting, to sug-

gest the subjects for debate, and to consider the nominations for membership and report on them at the meeting at which they shall be balloted on.

Article VI.

Meetings.

1. The Association shall hold an annual meeting in the city of Washington, D. C., at a time designated by the Council.

2. The President shall call the meeting to order and open the session by an address not exceeding half an hour in length. In his absence the Vice-President shall preside, and in the absence of both these officers the senior Councillor.

3. Then shall follow original communications, discussions on subjects of general interest in the department of medicine and pathology, demonstrations in pathology, and miscellaneous business.

4. Authors of papers, and referees and co-referees who open a discussion shall not occupy more than thirty minutes each; and in the discussion following, the remarks of each speaker shall be limited to ten minutes.

5. The referees, co-referees, and authors of papers shall send abstracts of their papers to the Council for distribution to members previous to the meeting.

Article VII.

Quorum.

Any number of members present at the appointed time of the annual meeting shall constitute a quorum for the transaction of ordinary business, but for the election of members fifteen shall be necessary for a quorum; and for altering the Constitution, twenty-five members shall be necessary.

Article VIII.

Election of Members.

Nominations to membership, signed by two members, must be made in writing at an annual meeting of the Association; and within six months of the time of nomination the nominators shall transmit to the Council letters stating the qualifications of the nominee and also a list of his professional positions and publications. The Council shall

report those nominations which are approved by it to the next annual meeting for action. An affirmative vote of three-fourths of the members present shall be necessary for the election of active members, but for the election of honorary members an unanimous vote of those present shall be required.

Article IX.

Annual Dues.

The annual dues of the Association shall be fifteen dollars, from the payment of which honorary members shall be exempt.

Article X.

Amendments to Constitution.

Amendments to the Constitution must be proposed in writing by five members at an annual meeting and must be acted upon at the succeeding annual meeting, the notices for which shall contain an announcement of the proposed amendments; and such amendments shall require for their adoption an affirmative vote of three-fourths of those present.

Dr. Charles F. Folsom read a paper on "The Early Stages of General Paralysis," which was discussed by Drs. Edes, Mitchell, Putnam, Pepper, and Folsom.

Dr. James Stewart and Dr. John T. Carpenter each read a paper on "Tetany," which were discussed by Drs. Kinnicutt, Miles, Jacobi, Putnam, Stewart, Carpenter and Mitchell.

Adjourned at 1.10 P. M.

Afternoon Session.

Meeting called to order at 2.45 P. M., by President Minot.

Dr. A. Brayton Ball read a paper on "Thrombosis of the Cerebral Sinuses and Veins," which was discussed by Drs. Osler, Jacobi, and Welch.

Dr. Samuel C. Busey read a paper on "Chylous Effusions into Serous Cavities," which was discussed by Drs. Osler and Welch.

Dr. J. F. A. Adams read a paper on "Substitutes for Opium in Chronic Diseases," which was discussed by Drs. Dana and Garland.

Dr. D. W. Prentiss exhibited a man presenting a remarkably slow pulse, but the reading of his paper was postponed until the next day. The patient was examined by several members, his pulse at that time being 34.

The Auditing Committee reported that they had examined the Treasurer's accounts and found them to be correct.

Adjourned at 5.45 P. M.

SEPTEMBER 19TH.—MORNING SESSION.

Meeting called to order at 10.10 A. M., by President Minot.

Dr. Prentiss read a paper on "Slow Pulse," which was discussed by Drs. Mitchell, Kinnicutt, Jacobi, Edes, and Osler.

Dr. Frederick P. Henry, the Referee, opened the discussion "On the Relation between Chlorosis, Simple Anæmia, and Pernicious Anæmia, including Leucocythæmia and Hodgkin's Disease." In the absence of the Co-Referee, Dr. Forchheimer, his paper was read by Dr. Pepper; and the subject was further discussed by Drs. Osler, Kinnicutt, Johnston, I. T. Dana, Pepper, and Henry.

Dr. Weir-Mitchell read a paper on "Subjective False Sensations of Cold," which was discussed by Drs. Putnam and Miles.

Dr. Garland read a paper on "Gastric Neurasthenia," the discussion of which was postponed until the afternoon session.

A Mr. Shepherd, whose pulse was 32, presented himself before the Association for examination, having heard of Dr. Prentiss's paper on "Slow Pulse."

Adjourned at 1.10 P. M.

AFTERNOON SESSION.

Meeting called to order at 2.45 P. M., by President Minot.

Dr. Garland's paper on "Gastric Neurasthenia" was discussed by Drs. Mitchell, Pepper, Kinnicutt and Garland.

Specimens from two cases of cretinism sent by Dr. W. F. Whitney were exhibited.

Dr. John H. Musser read a paper on "Primary Cancer of the Gall-bladder and Ducts," which was discussed by Dr. Baumgarten.

Dr. Henry F. Formad read a paper on the "Anatomical and Physiological Relations of Lesions of the Heart and Kidneys," which was discussed by Dr. Baumgarten.

Dr. P. G. Robinson read a paper on the "Contagium of Diphtheria," which was discussed by Drs. Atkinson and Formad.

Dr. I. E. Atkinson exhibited two sphygmograms taken from cases of slow pulse.

Adjourned at 5 P. M.

SEPTEMBER 20TH.—MORNING SESSION.

Meeting called to order at 10.20 A. M., by President Minot.

On motion of Dr. Busey, it was resolved that the Secretary be instructed to convey to the Surgeon-General the thanks of the Association for his kindness in allowing the Association to hold its meetings in the Library.

On motion of Dr. Busey, it was resolved that the nominations for membership shall not hereafter be read in open meeting until after they have been approved by the Council.

On motion of Dr. Busey, it was resolved that the Council be instructed to appoint the date of the next meeting between May 20th and June 15th, 1890.

The following officers, nominated by the Council, were unanimously elected:

President—S. C. Busey.

Vice-Presidents—William Pepper and Henry M. Lyman.

Recorder—I. Minis Hays.

Secretary—Henry Hun.

Treasurer—W. W. Johnston.

Council—G. Baumgarten.

Representative on Executive Committee of Congress of American Physicians and Surgeons, William Pepper.

The following gentlemen, whose nominations were approved by the Council, were elected members:

Drs. Wm. G. Thompson, Wm. H. Thomson, and J. West Roosevelt, of New York; Drs. Charles Carey and Charles G. Stockton, of Buffalo; Drs. Victor Vaughan and Heneage Gibbes, of Ann Arbor; Dr. Charles W. Purdy, of Chicago; Dr. Starling Loving, of Columbus, O.;

Dr. W. H. Geddings, of Aiken, S. C.; Dr. Wm. C. Dabney, of Charlottesville, Va.; Dr. B. F. Westbrook, of Brooklyn; and Dr. Henry P. Walcott, of Cambridge, Mass.

On motion of Dr. Pepper, with the approval of Dr. Osler, it was resolved that the discussion on Rheumatism and Rheumatoid Arthritis be postponed and made a subject for next year, and that Dr. Osler be given permission to publish his paper in the volume of *Transactions*.

Dr. James J. Putnam read a paper entitled "A Supplementary Inquiry into the Frequency with which Lead is Found in the Urine," which was discussed by Dr. Welch.

Dr. Harold C. Ernst read a paper entitled "How far may a Cow be Tuberculous before the Milk becomes Dangerous as a Food Supply?" which was discussed by Drs. Councilman and Welch.

In the absence of Dr. Trudeau, his paper on "Hot Air Inhalations in Tuberculosis," was read by Dr. Welch.

In the absence of Dr. Whittier, his paper on "Primary Malignant Disease of the Duodenum," was read by title.

Dr. William Osler presented a patient suffering from spina bifida.

Adjourned at 12.40 P. M.

HENRY HUN, *Secretary*.

DECEASED MEMBERS.

EDWARD T. BRUEN, M.D. University of Pennsylvania, 1873; Assistant Professor of Physical Diagnosis in the University of Pennsylvania; Visiting Physician to the Philadelphia and German Hospitals. Author of a work on the "Physical Diagnosis of the Heart and Lungs." He was born in 1851, and died March 31, 1889.

ALONZO CLARK, M.D. College of Physicians and Surgeons, New York, 1855; Professor of Pathology and the Practice of Medicine in the College of Physicians and Surgeons, New York. He was born on March 1, 1807, and died on September 13, 1887.

JOHN CALL DALTON, M.D. Harvard University, 1847; Professor in the Medical Department of the University of Buffalo, 1851–54; Professor in the Vermont Medical College, at Woodstock, 1854–59; Professor of Physiology in the Long Island College Hospital, 1859–61; Professor of Physiology in College of Physicians and Surgeons, New York, 1855–83; President of the College of Physicians and Surgeons; Member of the National Academy of Sciences; Vice-President of the New York Academy of Medicine, State Medical Society, New York Pathological Society, Medical Journal Association, and Medical Society of New York. Among Dr. Dalton's most important publications were the following: "Corpus Luteum," "A Treatise on Human Physiology," "A Treatise on Physiology and Hygiene for Schools, Families and Colleges," "The Experimental Method of Medicine," "Doctrines of the Circulation," and "Topographical Anatomy of the Brain." He was born February 2, 1825, and died on February 12, 1889.

R. PALMER HOWARD, M.D., LL.D., McGill University, 1848; Professor of Medicine and Dean of the Medical Faculty in McGill University; Demonstrator of Anatomy, 1852–54; Professor of Medical Juris-

prudence, 1854–56; Professor of Clinical Medicine, 1856–60; Professor of Medicine, 1860; and Dean of the Medical Faculty of McGill University, 1882; Visiting Physician to, and Secretary of Montreal General Hospital; President of Canada Medical Association; President of College of Physicians and Surgeons of Quebec; President of the Medico-Chirurgical Society of Montreal; Fellow of the College of Physicians of Philadelphia. He was born January 12, 1823, and died March 28, 1889.

Henry D. Schmidt, M.D. University of Pennsylvania, 1858; Visiting Physician to the Charity Hospital, New Orleans, La. Died on November 23, 1888.

THE PRESIDENT'S ADDRESS.

THE PROGRESS OF MEDICINE DURING THE LAST FIFTY YEARS.

By FRANCIS MINOT, M.D.,
HERSEY PROFESSOR OF THE THEORY AND PRACTICE OF PHYSIC IN HARVARD UNIVERSITY, BOSTON.

If we consider the progress which medical science has made during the past fifty years and its position at the present day, we are led to hope that the time is not far distant when the healing art will approximate in certainty to the exact sciences. Not many years ago, for example, it seemed impossible that a correct diagnosis of the principal structural diseases of the brain and spinal cord could ever be attained, and yet we are now almost as familiar with their characteristic symptoms and with the nature and anatomical situation of their lesions as with those of the lungs, the heart, or the pleura. The twin departments of physiology and pathology (the former was born almost within the memory of some of us) have made immense strides, and, along with improved methods of clinical observation and research, have aided more than anything else in the advancement of our knowledge of disease and its treatment during the past half century. Bacteriology has revolutionized our notions of the causes and nature of many diseases, and of their proper management. A great amount of useless and pernicious medication has been abandoned, while the number of valuable remedies has been increased. The principle of prevention is advancing in proportion to our increased knowledge of the causes of disease, and hygiene has become an important branch of medical education. Even in tuberculosis, the most widespread and fatal of maladies, the results of prophylactic treatment, founded in part on the great discovery of Koch, are found to be most encouraging, and it is not unreasonable to

hope that the disease may in time become as controllable as is small-pox at the present day.

Many other recent advances in medicine readily occur to us. I need only mention the progress in State medicine, in public hygiene, in the construction of hospitals, in our acquaintance with the laws of climatic treatment of disease—passing by many others which the limited time at my disposal prevents me from noticing. In no department of medicine, however, has development been more conspicuous than in that of teaching. Formerly, good teachers were rare, and students were compelled to acquire what knowledge they could chiefly by listening to didactic lectures. In my day there was but one teacher in clinical medicine in Harvard Medical School, and he could give but little time to it, being at the same time professor of materia medica; whereas now clinical teaching has to a great extent supplanted didactic lectures in all medical schools. New departments for the study of the various specialties have been created, and provided with competent teachers and well-equipped laboratories, and it cannot be long before a full course of at least four years' study will be required of every applicant for the degree of doctor of medicine.

Did time allow, it would be interesting to study the causes of this great advance in medical science, but I can barely allude to them. In many respects the influences are the same as in the case of other sciences, both physical and moral. Each step forward of one helps the growth of others. Medicine is almost as much indebted for the position it now holds to biology, to chemistry, and other branches of physical science, and even to mechanical art, as to clinical observation and pathology. Electricity puts us in touch with the whole civilized world, and every new discovery in science and art is immediately announced from one hemisphere to the other. Communication between distant regions is abridged by railroads and steamships, and scientists whose homes are thousands of miles apart can come together with comparative ease for the interchange of knowledge. We must, indeed, ascribe to the more frequent professional intercourse which we enjoy a prominent influence on the growth of medical science, as of science in general. In small communities physicians do not often meet for the discussion of medical subjects, and stagnation of ideas is apt to arise from the lack of diffusion of personal knowledge; but when large numbers are gathered together from distant parts, differences of experi-

ence and observation give rise to discussion and to the development of new ideas. We find, for instance, that diseases may vary in clinical aspect, in severity, and in methods of efficient treatment according to geographical situation, climate, elevation, race, and modes of life. Some are more or less strictly confined to certain regions, and our knowledge of them must be obtained from observers living in those regions, or visiting them. The treatment of disease, both general and special, often varies much in different countries and in different parts of the same country. In some it is active, including a large amount of medication; in others it is more passive, being directed rather to the condition of the patient and to the special symptoms which he exhibits, than to the disease itself. Certain widespread diseases, specific in their nature and self-limited in duration, are found to be but little influenced in their mortality either by geographical locality or by different and opposite modes of treatment, while, on the other hand, age, constitution, habits, and complications play a much more important part in the result. This is strikingly shown in the various papers on the mortality of pneumonia which have appeared in different medical journals during the past year.

It is not easy to overrate the great influence of the medical press in elevating the standard of the profession, and in the diffusion of scientific knowledge in all parts of the world by the publication of original articles, clinical and other lectures, reports of interesting and instructive cases, and proceedings of societies and conventions. Thousands of practitioners who are unable to leave their homes are thus brought into communication with the highest authorities in medicine, and can avail themselves of the most recent advances of medical science.

Finally, we must recognize as one of the great advantages of medical conventions the privilege of becoming personally acquainted with men from all parts of our country whom we have hitherto known only by reputation, or through their writings. In this way the profession is more closely drawn together, sectional prejudices are allayed, harmony of ideas on the subject of medical improvement is promoted, and the foundation is laid of enduring and delightful friendships.

The organization of this Association is peculiarly adapted to aid the progress of medical science. It represents no one section of our country, but includes practitioners from all parts of the United States and Canada, whose experience, observation, knowledge, and ability are

brought together for comparison and for mutual instruction. The programme for the present session includes many subjects of interest and importance, and its length warns me that I must no longer trespass upon your time.

The duty remains to me to announce officially the deaths of four of our members, which have occurred since our last meeting.

H. D. Schmidt, of New Orleans, an original member, died November 23, 1888. He was a distinguished pathologist, and was long connected with the Charity Hospital of New Orleans. He had been an invalid for years, and never attended a meeting of the Association.

John Call Dalton, an honorary member, died in New York, February 12, 1889, at the age of sixty-four years. For nearly thirty years he was Professor of Physiology in the College of Physicians and Surgeons in New York, which chair he resigned to become President of the College, holding that office at the time of his death. His treatise on *Human Physiology* has passed through many editions and is widely known. His standing as a scientific man was of the highest order, and personally he was greatly esteemed and beloved.

Robert Palmer Howard, of Montreal, an original member, and one of the vice-presidents of the Association, Professor and Dean of the Medical Faculty of McGill University, and Physician of Montreal General Hospital, died in Montreal March 28, 1889, aged sixty-six years. Dr. Howard took an active part in the formation of the Association, and was one of its most valuable members. His paper on "Hepatic Cirrhosis in Children," read at the second meeting, will be remembered as an interesting memoir on that subject. He was preeminent among American physicians as a teacher, a writer, and a practitioner. The Association has sustained a severe loss in his death.

Edward T. Bruen, of Philadelphia, an original member, Assistant Professor of Physical Diagnosis in the University of Pennsylvania, and Physician to the Philadelphia and German Hospitals, died May 31, 1889, aged thirty-eight years. He furnished two papers to the Association, one on "Diaphragmatic Pleurisy," read at the first meeting, the other on "Bergeon's Method of Treating Phthisis," at the second meeting. In his comparatively short life Dr. Bruen had attained a high position as a writer and teacher in clinical medicine, and his death deprives the Association of a most valued member.

THE EARLY STAGE OF GENERAL PARALYSIS.

By CHARLES F. FOLSOM, M.D.,
VISITING PHYSICIAN, BOSTON CITY HOSPITAL.

Lasègue, in his thesis as professor agrégé in 1853, described an initial stage of general paralysis of the insane, without the striking symptoms, then all but universally considered as necessarily marking that disease; and in a paper in the *Annual Report of the Academy of Sciences* in 1860, Brierre de Boismont published cases illustrating the same point, the most striking of which was that of a man who began thieving nearly eight years before the diagnosis of general paralysis was made. Voisin, in his exhaustive monograph on general paralysis in 1879, and Luys, in 1881, mention an obscure prodromal period, but yet, as in Lasègue's and de Boismont's cases, with marked, although not distinctive, mental symptoms. It is not until the appearance of Prof. Ball's work in 1883, and that of his former *chef de clinique*, Régis, in 1885, that I find in French special medical literature a clear statement of the very insidious and obscure character of the first symptoms of general paralysis.

Since Sander's article in the *Berl. klin. Wochenschrift* in 1876, the leading German writers on diseases of the brain, especially Wernicke, Schüle, Krafft-Ebing, and Mendel, in his admirable monograph, have described the beginning of general paralysis as being simply a change of character quietly developing, and, later, so slight an impairment of intelligence as to admit of patients continuing their usual occupations for a considerable time without any indications of diminished mental power noticed except by those who come in contact with them most intimately, and by them not thought of as indicating disease.

In Great Britain, Savage, in 1884, alludes to a prodromal stage in general paralysis, but as attended with developed rather than initial symptoms, although he admits that there are certain vague and vari-

able nervous symptoms in which he always gives a guarded prognosis, and where he suggests that proper intervals of rest might prevent further progress; but Sankey, writing the same year, fails to recognize so early a stage. Clouston, in his *Clinical Lectures on Mental Diseases*, 1883, does not describe the initial or prodromal stage. Mickle, in the second edition of his painstaking monograph on general paralysis, in 1886, mentions a prodromic stage, but with symptoms marking some progress in the disease, although he states that "in the history of many a case do we find that some moral or other mental change in the patient, some perversion of the affective sentiments, has been noticed long before the acknowledged onset of the disease;" and in the meantime it has happened that fortunes have been wrecked or characters ruined.

In this country, Spitzka, in his treatise on insanity, in 1883, defines the initial stage of general paralysis as so insidious in its development of symptoms that it is difficult to say anything positive as to its duration, and as marked by change of character, attributable to simple brain failure, especially in negligence of ordinary duties, or indifference to them.

The impression of general paralysis, however, almost universal among officers of insane asylums and the medical profession, is of a disease in which the symptoms are early difficulty of speech, muscular tremor, and uncertain gait, accompanied by remarkable mental weakness, and in many cases *manie des grandeurs*.[1] The only general medical text-books describing the obscure insidious stage are the second edition of Strümpell and Pepper's *System of Medicine;* and, excepting Meynert, the writers who have recognized it, so far as their opinions are given, agree with Voisin as to the impossibility of diagnosticating general paralysis in this early stage.

Indeed, the early period of the disease, as generally described, is a comparatively late stage, and, excepting a few writers, this statement holds good at least until a few years ago. With regard to the occasional articles in medical journals which have appeared from time to time within the last forty years on the prodromal symptoms of general paralysis, reference has for the most part been made to particular acts rather than to a general mental state.

[1] Bucknill and Tuke.

CASE I.—In 1880, I was asked to see a gentleman who had been committed to a State prison for bigamy, with the following history given to me by the officers of the prison: He was a little over forty years old, in the prime of life, of vigorous, healthy constitution, married, and had borne a good character. During an absence from home he fell in with a girl whom he persuaded to marry him. I was not able to see any of his family, and so did not learn all of the circumstances of the case; but the statement at the prison was that such an act on his part was to his family evidence of insanity. Whether they had observed other indications of mental deterioration, I do not know.

Mr. —— became excited, and was sent to an insane asylum, where he was kept quiet and in seclusion from April 20 to August 13, 1878, under conditions of quiet, where slight mental impairment might not be detected except by special methods of examination. No delusion was observed, no extravagant act, or mental depression considered pathological, and no exhilaration, except slight and transient, was found. He seemed to reason well enough, to be intelligent, and, so far as was ascertained, to show no striking impairment of memory. The medical superintendent of the asylum kindly wrote in reply to my inquiries that the patient was brought to the asylum by the sheriff, and he continues: "He was brought to the hospital soon after I took charge of it, and among so many patients, all new to me, I did not see him so often, or observe him so closely as I should have done a few months later. I remember him as slightly exhilarated when he entered the hospital, fond of talking, and an easy, fluent talker, not tidy, but rather careless of his clothing. No motor symptoms were observed, and had they been present I think I should have noticed them, as I had, while at the —— Asylum, been especially interested in the study of cases of paresis. The exhilaration soon passed away, and was followed by what seemed to be his natural manner—of a pleasant, social, rather gentlemanly man. He was, finally, considered well, and removed by the sheriff, although I have no doubt that a close scrutiny of his mental state would, at that time, have revealed the same kind and degree of impairment that was found at the prison." The jury found him guilty of bigamy, and he was sent to a State prison, his family still protesting, as I was told. The prison officials set him to work where he had to use his mind and coördinate his muscles in new employments, and under new associations of place, etc.; and the fact was shown, although not early learned, that the brain had lost an indescribable something of its capacity, and that the prisoner was no longer thoroughly himself. He was punished, fed on bread and water, kept in a solitary cell, and tried at every possible kind of work. He was not persistently refractory, never gave any trouble except from the inefficient manner in which he got through with any employment given him to do, and he seemed willing to do anything he was told. But either he could not or would not concentrate his attention continuously in one direction, so that he did not do anything well for more than a short time.

At last he could not be trusted even to carry potatoes, quite a distance to be sure, from the store-room to the cook, without some one being on hand to keep him at his work. He seemed indifferent or placidly apathetic. Finally

the warden of the prison, after nearly two years of steadily but very slowly progressive mental impairment, with gradually failing strength also, came to the conclusion that he did not do his work properly because he could not, and I was requested to ascertain what was the matter with him. He was thereupon declared to be a general paralytic and sent to an insane asylum, but to a different one from that in which he had been before. There, also, there was found no characteristic muscular tremor nor embarrassment of speech, no staggering gait nor delirium of exaltation, and much to my surprise my diagnosis of general paralysis was disputed. The typical symptoms of advanced general paralysis appeared later, and in time ended in the usual way by death.

CASE II.—Mr. ——, a man of vigorous frame, forty-five years old, in the prime of life, brought up in the country, and considered strong enough to be capable of any amount of work, married, without children. He was of a healthy family, had never had any serious illness, and denied any history of syphilis—a statement, to be sure, which is often of very little value. He had been considered an extraordinary salesman, and was employed in one of the immense establishments in ——, at the unusual salary of $4500 a year. The firm gave him a two weeks' vacation, two years before I saw him, and upon his return his place was filled by another. None of the partners or employés thought of any mental disease in his case. The reason that he was dropped was because he had lost his faculty of making ready sales. As they said, his services were not only not worth the money they had been paying, but they did not care to keep him at a moderate salary. His wife then found, that although she had been economizing and they had been living at a hotel to save money, her husband had not anything laid by, and yet he could not or would not explain where the money had all gone. She rented a dwelling in the desirable part of the city, and kept a boarding-house in order to support the family, for she soon found that her husband had lost his energy and force, and was not to be depended upon to earn anything. He believed that he had lost his situation, and that another had got it, through favoritism, and for some time so his wife thought. He seemed rather indifferent than idle, and was placid, apathetic, inclined to be dull, silent, or absent-minded; and yet he went about almost daily from shop to shop to find a situation, but in such an unenergetic way that no one cared to give him employment, although the beginning of mental disease was not suspected.

He read the newspapers, performed such offices and services about the house as are usually done by a man, and well enough. It was his duty to sit up at night to open the door for those who were out late, and to do the various commissions and errands of the house. Finally, he several times went to the door late at night so inadequately dressed as to excite remark, although not indecent, and showed a lack of his usual sense of delicacy in other matters, facts which he later either did not fully realize or would not acknowledge. His relations to his wife had become so inconsiderate that she had to keep her apartment locked at night, and once had to threaten to

call a policeman, although there was marked loss of sexual power, in spite of increased sexual desire.

Upon examination at his house, one morning, just as he had finished reading the daily paper, I found him able to converse intelligently on the news of the day. He had lost something in flesh and strength, although eating very heartily, but I could not find any other physical symptoms of disease, unless possibly an unnatural deliberateness in conversation, and perhaps a trifling sluggishness in speech. There seemed to me a lack of animation in his expression, a want of interest and initiative, a trifling degree of failure in quickness of memory and intellectual promptness which indicated in two years such a deterioration from a man who could command a salary of $4500 a year, as, other conditions having been carefully excluded, to warrant the diagnosis of general paralysis; and yet without a previous standard for comparison, my examination would simply have rated him as a quite ordinary man. He fortunately went to an insane asylum, as a voluntary patient, for the case was not one in which I could advise signing a certificate. There, the exertion of adapting himself to the changed conditions, and his new relations to the world, and the necessity of doing other than routine acts to which he had long been accustomed, at once developed, perhaps I should say revealed, a marked intellectual impairment, which in a few years more ended in death in the usual way of general paralytics.

Case III.—A strong farmer in the prime of life; born in Ireland. His wife's statement was a story not unlike that of Case II.—that is, of a man who could talk well enough to the neighbors and doctors, but who could not do things as he used. The immediate reason of her consulting a physician was that her husband frequently got up at night and went about the house as if he had forgotten something, or wished to assure himself that everything was safe; but he did not manifest any delusion, delirium, incoherence, or indeed any symptoms which suggested to her mind mental disorder, until on a few occasions he became violent when advised to go back to his bed. My careful examination was negative as to definite mental or physical symptoms. The patient, though living under conditions favorable to health and eating voraciously, had lost flesh and strength and complained of being easily tired. His speech was deliberate rather than sluggish, and he was slow in his physical movements as in his mental action. His face showed some lack of animation, and his mental state seemed one of indifference—symptoms which his wife realized for the first time in having her attention called to them and which she said were of recent origin, although in ordinary common talk he appeared as well as many farmers. His wife also said that he had become rather silent, inactive, and irritable on opposition. The diagnosis was general paralysis, and the patient was sent to an insane asylum as a voluntary patient without commitment, and there failed so rapidly that he died a well-marked general paralytic about a year later.

Case IV.—Mr. ——, a strong, healthy man in the prime of life, who had overworked and deprived himself in many ways to get his professional education, was very successful in the practice of law, married, had three

children, and lived in a degree of luxury unknown to his earlier years. Being of agreeable manners, a good public speaker, a ready parliamentarian and an able political organizer, he was elected and reëlected mayor of his city, and was made chairman of the local republican committee. He was observed to be in remarkably good spirits; his gaiety, wit, and readiness in speech surprised his friends. He was called upon to make speeches at fairs, dinners, and social as well as political occasions, and his associates even thought of him, in his newly acquired abilities, as a probable candidate for the governor's chair. His mental state was looked upon as that of an unusually happy and successful man, and by no means as that of a morbid exhilaration. It was soon noticed that he lacked his usual good sense and judgment.

Although he attended to his ordinary routine of office and law business, he did not do so with his usual care and punctuality, and at length he succeeded in having done so many little acts not agreeable to people, which they considered due to slights, negligence, or indifference, that, from being one of the most popular, he became the most disliked man in his circle. The first striking misdeed committed by him was in the heat of the Butler campaign, when he engaged to speak in a republican party meeting, still being chairman of the local republican committee, but went to another city, saying nothing in explanation of his disappointing the audience waiting for him in the first city, and addressed the opposition in fierce denunciation of his own party, but so ably that mental disorder was not suspected. His law partner said that he frequently remonstrated with him for being careless or negligent of his professional duties, for he even wrote business letters in such a way that they needed to be overlooked before leaving the office, but all this was explained on the ground of Mr. S. being too much interested in politics, fairs, public dinners, etc., beside having attempted too much in being mayor of a city and at the same time having a large law practice. Still, no one had any idea that he was ill, and he was retained as counsel in a contested will case involving several million dollars, two years after the beginning of the symptoms just related. His physical weakness was then the only symptom suggesting possible illness to his family or friends. He had once or twice fallen in the street, but his explanation was that he had stumbled or tripped. Once, also, he had seemed to be faint and prostrated for several minutes, but did not fall; otherwise his physical health was said to be perfect. As his circumstances were ample, his children were sent away, his home was converted into a hospital for the occasion, after his symptoms became so marked as to call for a consultation, and he died a typical case of general paralysis.

Case V.—Mrs. ——, a strong, healthy lady, in the prime of life, the death of whose husband, four yearsprevious, after a severe and protracted illness from a disease said to be epilepsy, had reduced her from comfort to the necessity of maintaining herself. She became an attendant in a public institution, but in a couple of years had to give up from diminishing physical strength and indisposition or inability to make sufficient mental exertion to perform her duties. She went to New York City to live. Her symptoms were so vague and ill-defined that she was treated by the leading physicians there for

their prevalent disease, malaria; all that she complained of being as above described, with a feeling of weariness and soreness, or rather lameness, throughout her legs after walking. She could talk well enough not to indicate any mental impairment, but close questioning of her and her friends revealed the fact that she could not do things with her former facility. Attention, concentration, exactness of memory, readiness of perception or suggestion, were clearly impaired. There were no evident physical signs except a slowness and deliberateness rather than real sluggishness of speech, and of physical as well as mental action generally. To the diagnosis of general paralysis was added the prognosis that in an asylum she might live a couple of years, and much longer with the care and comforts of a home—in which she died about four years later.

CASE VI.—Miss ——, also of good constitution and previous good health. Four years before, she had been treated for epilepsy, in the Isle of Wight, with the bromides. Later she consulted Professor Ball, of Paris, who discontinued her medicine, but whose diagnosis I did not learn. After her return to Boston, she was supposed to have nervous prostration and convulsive attacks of hysterical origin. I was called in consultation with the full expectation that I should confirm the diagnosis, and approve a rest cure, with seclusion, massage, etc. The attending physician and family were exceedingly surprised at the formerly unsuspected loss of intellectual power which a close examination brought out, and there were none of the indications usually thought necessary to a diagnosis of any brain disease, much less of general paralysis; but there were sufficient symmetrical mental impairment and muscular deterioration to justify that view of the case, which the patient's subsequent history and death fully confirmed.

CASE VII.—Mr. ——, the senior partner in a highly successful commercial house, of strong constitution and perfect early health, above fifty years of age, consulted a distinguished laryngologist by his wife's request, because she, who was somewhat deaf, could no longer hear him speak as clearly as before. No local trouble was found, and the disorder being supposed to be of nervous origin, the suggestion was made that he should consult me. He was then, according to his partners, attending to his routine duties well enough, except that he became tired or exhausted long before the day was over, and then was captious, irritable, and meddling, to an annoying extent. His talk was occasionally at such times a trifle inconsequent, or not wholly to the point. There were no delusions, no delirium, no extravagant conduct, or, indeed, anything to lead his wife to suspect serious trouble, much less mental trouble. She had noticed, however, that he could not take up new work with facility, and that he could not remember for more than a very short time the recent stories that he read, and yet he conversed intelligently and well regarding the news of the day, and could remember well enough past events, some of them with accuracy. The routine duties of home were performed, so far as she saw, as well as usual, although she admitted that he had become careless, inattentive, and negligent of some little things, and she too had observed the slight change in character. He was very fond of driving a pair of fast horses, which

he did as well as ever, even after his business hours, when he was somewhat wearied with the day's work—that is to say, no mishap occurred. The hands were steady, and he wrote apparently as well as ever, but his articulation was distinctly less clear to his deaf wife, although some of his friends thought that the difficulty lay in her ears. The change in his speech noticed by his partners was, that in giving orders across their large warerooms his voice was raised, as if with more effort, and that the sentences came out a little more explosively. The diagnosis of general paralysis was made, and rest ordered. But the difficulty of getting him away from his business was such that I finally advised a trip to Europe, being confident that the disease would show simply the mild symptoms of the prodromal period long enough for him to get home with safety. To our surprise, he was in this matter pliant, apathetic, almost indifferent—although naturally quite independent in character, and rather self-willed—and readily consented to the plan.

On the steamer out he behaved exceedingly well, and there was, on his part, no impropriety of any kind. Rest and freedom from care alleviated even those mild symptoms which existed, and his illness was not suspected. In England and France he was thought to be lacking in interest and initiative, and he gradually became more so until on the return voyage, eight months later, his apathy had become noticeable, and his dulness and inertia were objects of remark. His articulation was becoming less clear, although not yet thick. He also was much more easily tired from physical exertion and was very irritable, and sometimes quite cross at his difficulty in making his wife understand him.

After his return home he went to a summer resort with his wife, and then for the first time showed delirium, but only at night, with delusions and some violence; at these times incoherence, confusion, and very considerable thickness of speech. Six months later the term of his partnership expired, but he still maintained such a clear business head, and advised as to the details of dissolving the firm so well, that his partners and some friends insisted that I must have made a mistake in diagnosis, and attempted to persuade him to continue the partnership, and remain at the head of the firm for another term of five years. Even after that he continued to manage his personal fortune for some time; but the typical symptoms of general paralysis of the classic form appeared, and made progress in the familiar way. The patient was a very troublesome one, but, with two nurses, was kept at home until his death, between two and three years later.

CASE VIII.—Mr. ——, of robust health and vigorous frame, brought up on a farm, and in the prime of life. In college he struggled with inadequate means and overworked for his education. Later he became exceedingly prosperous, and still overworked to maintain, in the law and as an instructor, a position for which he had not fully prepared himself, in the meanwhile living in luxury. His wife was pained to find that he at times treated her with great irritation and short, sudden explosions of almost anger. He became interested in a pretty servant girl, whom he wanted to educate. He was restless, excitable, and talked with a carelessness quite unlike himself.

Otherwise the symptoms were chiefly negative. He attended church with propriety and performed his professional work with the same excess of zeal and industry as before. His family physician, a very acute observer, did not see any distinct mental impairment, and did not anticipate mental disease, when I was called in consultation.

I was unable to make a diagnosis from a two hours' interview, and, indeed, until I took the patient off for a few days for constant observation. The first day he went to a dinner party after a long rest, and appeared so well that even after drinking a glass of wine he was not suspected of having anything the matter with him. But keeping him up late at night and tiring him out playing cards, to the point of weariness, etc., I soon found a symmetrical mental impairment when judged by the criterion of what he could do rather than by how he could talk, which, other diseases being excluded, could mean only general paralysis, and that was the diagnosis made. The physical signs were of lessened strength and endurance, more slowness of action, not so great a disposition to make an effort, and a deliberate rather than distinctly slow or sluggish articulation, which was much more noticeable when the patient was tired.

As it was important that he should be got away from his surroundings and associations, I sent him to Europe with a medical companion, to whom I gave a letter to Prof. Luys, near Paris, in case it should be necessary to avail ourselves of his private asylum. In Paris the patient saw Prof. Ball, by my advice, who found no urgent symptoms, and sent him to a hotel in the south of France, giving him a stimulating tonic. Mr. —— had improved so much that the absolute quiet and rest which I expected did not seem necessary. Finally, he took books, quietly insisting that they were his own, and misappropriated various things at his hotel in such a way that the proprietor insisted that he was thieving, until the symptoms indicated approaching violence, when he was sent to Prof. Luys' private asylum, and nearly four years later died at home, after having had all the classical symptoms of general paralysis.

Case IX.—Dr. ——, a physician, practising in the West, was observed by his wife to become excitable, talkative, and a little light-headed, after taking an amount of wine to which he had been accustomed for years without any stimulating effect whatever. She said that she remarked upon the fact repeatedly, but did not notice anything else singular for several months, when they went to Portland to be with her sister dying of cancer. The long journey tired him exceedingly, and he was so inattentive about tickets, baggage, etc., that she had to attend to them herself. Arriving at Portland, the physicians and surgeons invited him to make the hospital visits with them, when they were surprised at what they considered his bad manners in offering to perform surgical operations on their patients, and in telling them that he could treat their medical patients better than they could. They thought him very careless in leaving his horse on the street, but supposed that might be his way. The symptoms were otherwise negative, as told to me, but had

rapidly developed, when I saw him, into a clear case of typical general paralysis, which ended in the common manner.

CASE X.—Mr. ——, an English actor, of robust frame, of previous vigorous health, and in the prime of life. His wife first observed that, although he played his old parts well enough, he could not commit new parts to memory and play them well. He soon lost animation and force in his accustomed parts, and seemed to lose his grade of an actor able to take important parts. He did so poorly that his managers did not care to employ him longer, although there was no conspicuous fault. He became irritable, indifferent, somewhat apathetic, slow in all his mental and physical action, and with deliberate tardy speech. When I saw him, the other indications were chiefly negative, except as above, and that his facial expression had lost something in interest and force. He had also beginning atrophy of both optic disks, the only case in my experience where that symptom was found, except at a late stage. A year afterward he began to show ataxia and a sense of personal exaltation, symptoms which finally became so marked that he was sent to an insane asylum, where he died not very long after.

CASE XI. I have already published in Pepper's *American System of Medicine*. Mr. ——, age fifty-two, married, a clergyman: his mother died of apoplexy; two of his four brothers are insane. He had the usual illnesses of childhood in mild form, diphtheria of the worst type in 1869, and in recent years, according to his belief, malaria, as he had lived in a malarial region eleven years. As a young man he was of robust frame and vigorous health, brought up on a farm. He overworked, denied himself, and, in getting his education, overtaxed a brain not trained from early years to exacting labor. In 1877, for the first time, and at intervals since then, he had attacks of mental confusion, dimness in sight, and indistinct articulation, lasting from a few moments to several minutes. In 1882, after great emotional strain, people began to notice that his preaching had lost in animation and force, and they complained that he had become more radical in his views. Great mental worries occurred soon after. There had been no alcoholic or other excess, except of mental overwork. In 1883, in the dark, while feeling tired mentally and physically, but, he thought, not ill or dizzy, in alighting from a coach he missed the step and came to the ground on his feet with great force. He walked to the house of a friend, and was found by one of the family on their entry floor groaning, but not unconscious. He could not stand or talk, vomited incessantly, and complained of a horrible pain in the back and top of his head. Two days later, and each succeeding Sunday, he preached, obstinately and unlike him refusing to listen to advice to keep quiet; but he remained in bed between Sundays for three weeks, when the striking symptoms disappeared; but he had never felt entirely well since then—never had the same animation. He was supplying various pulpits, and found, wherever he had preached before, that people complained that there was a general lack of vigor in his preaching. In 1883 he observed that his right leg had less life in it than was natural, and soon after that both legs seemed heavy—that it was less easy to run up and down stairs, which his

wife also noticed several months later. He also had had for a year a strange feeling, a sort of numbness, in his legs. He thought that his handwriting and speech had continued as good as ever, but observed that he had to change to a stub pen, as he found difficulty in writing with the old sharper-pointed kind; that his voice had grown less clear. He never had any dizziness, pain, ache, or uncomfortable feeling about his head, except during the attacks already referred to. There had been no thoracic or abdominal symptoms, no neuralgia or rheumatism. Appetite and digestion had been faultless. He had lost about ten pounds in flesh. He had slept soundly, but was often restless, getting in and out of bed. He said that he was depressed for lack of employment; that he was not irritable, but that his family would say that he was not as tractable as formerly, not as patient, less easily satisfied; that his son and wife would say that he was not what he once was—that his memory is not as clear and vivid. He was conscious that within the last two years previous to consulting me in 1885 he had violent, uncontrollable, passionate outbreaks from trivial causes. He preached his old sermons, because he thought them too good to be lost, and because he took pleasure in rewriting them, in doing which he remarked that the handwriting became progressively worse toward the end of each sermon. He said that he could write better sermons, but did not like to make the effort. When he went into the pulpit a week ago he was told not to announce a second service, but everybody seemed to him so pleased with his preaching that a week later he gave word that there would be an evening service, to which, he laughingly said, only one person came. In standing with his eyes closed and feet together there was a little unsteadiness. On attempting to turn around or to stand on one foot with eyes closed somewhat more than the usual difficulty was experienced. In these trials the unsteadiness soon became very striking on prolonging the muscular effort. His hands had a powerful grasp, each marking seventy-four with the dynamometer, and on being stretched to their full extent, with fingers spread, immediately thereafter the fibrillary tremor could be seen only on close examination. There was no marked tremor of the muscles of the lips or face, except in movements which placed them at extreme tension. The tongue was tremulous on being protruded to its full length and held there. In walking in a rather dark entry the steps seemed to me shortened and the feet wider apart than in his usual gait, and he did not raise his feet as much, which he noticed also. In going up stairs he placed the whole foot, heel and all, on each step to keep his balance; he turned deliberately, keeping the feet near together and not raised from the landing; on coming down he evidently steadied himself by a muscular effort extending to his head and shoulders. The knee-jerk was well marked and alike in both legs, but I could not say that it was exaggerated. There had been no change in the sexual function.

His general mental state seemed to me to be of a quite superficial kind of despondency at his prospects, and yet absence of a corresponding degree of anxiety for the future; of satisfaction with his ability and worth; of a feeling that his family were unduly anxious about him; of a prevailing state of inap-

preciation of the whole situation, and of a general state of happiness which was abnormal—an opinion which his wife afterward corroborated. He was quite emotional, and easily and rapidly moved to smiles, and from them almost to tears.

In explaining his restlessness at night he stated that he was taking quinine for his malaria, and that it acted on the liver so as to increase the flow of urine, which he repeated several times, but laughingly said, "Of course; how foolish!" when I suggested that he meant the kidneys. In removing his clothes for a physical examination I found that he had two starched shirts on—the one in which he went from home, and that in which he preached. When I asked why he could not take home a soiled shirt in his valise after having brought a clean one in it, the idea struck him that he, after all, had done something foolish.

The examination of chest, abdomen, and of the urine was negative. I could not find anywhere evidence of anæsthesia, hyperæsthesia, or paræsthesia, general or local. The reaction of the muscles to the faradic current seemed normal. By ophthalmoscope and otherwise the eyes showed nothing abnormal. Hearing was also normal, as well as the other special senses. In a close examination I could at first not discover anything about his speech more than deliberation in articulation, which might perhaps have been natural to some scholarly men, but which I afterward learned had been only of recent origin, and increasing. It was more pronounced after the patient became a little wearied, when I found that he could not articulate a long word with several labials and linguals without manifest difficulty. I gave him a sheet of paper and asked him to write from top to bottom. He could not think of anything to write. When I told him to put down the text of his sermon of the previous day, he could not possibly remember it; no more could he call to mind a sentence or a sentiment from it. He copied an old sermon a few weeks previous to his visit to me, and a few pages were taken by me, respectively near the beginning and near the end of the copy. The natural handwriting is quite free, with an easy sweep of the pen. In the copy of the sermon the second page shows that the pen is held stiffly and tightly, and that the lines are not made with as steady a movement of the hand as in the old handwriting. The lower lines are a trifle worse than the upper, and pretty much like the third page, from which there is progressive deterioration to the end. The page written in my office was very carefully done, and, under the circumstances, is evidence of marked mental deterioration and muscular impairment.

I purposely made no remark to the patient, and he made no inquiry, about diagnosis or treatment. He would have missed his train, although there was a clock in my office, had I not reminded him of the late hour, whereupon he made all his arrangements with care, good judgment, and accuracy, and reached his home safely. As he walked briskly down the even sidewalk I doubt whether any one, even a physician, would have marked any unsteadiness or anything abnormal about his gait. If he had been followed a few blocks, until the idea of catching his train had ceased to stimulate him, and

after he had reached the crowded thoroughfares of the city, especially as he stepped up and down curbstones or walked slowly to avoid teams at crossings, a close examination would undoubtedly have shown the defects in gait already pointed out.

Mr. ——'s wife had noticed that her husband did not raise his feet as of old in walking—that he walked as if they were heavy, but under the influence of coca wine or a decided mental stimulus he walked apparently as well as ever for a short distance. She had noticed a slight impairment in memory, an increased fractiousness, a diminished ability to appreciate things in their proper light, a changeability in his moods and mental state, a scarcely observed but noticeable neglect or oversight of little customary duties, occasional passionate outbreaks from trifling causes, a disposition to laugh and cry easily; and that often he did and said unwonted foolish little things, like attributing increased flow of urine to his liver, wearing two starched shirts, announcing the Sunday evening service; but she had not considered any of the symptoms as evidence of disease, especially as he kept accounts, attended to his preaching, etc., and showed no manifest indications of a disturbed or impaired mind. She had remarked a decided change in the character of his handwriting, also an unusual deliberateness in speech, but no indistinctness or hesitation, although his voice had become less clear. He had had no delusions, illusions, hallucinations, or unreasonable ideas. It was for the weakness in his legs that she asked my advice.

I found that the mental and cerebral symptoms in this case had been overlooked, and that the weakness in the legs had been attributed to spinal concussion, for which a favorable prognosis had been given.

I first examined the patient after he had been away from home nine days, preaching two Sundays, and making many new acquaintances in the meanwhile, beside having travelled nearly two hundred miles by rail, so that he was fatigued. After three weeks' complete rest I saw him at his house. The knee-jerk was perhaps increased as compared with the previous examination. Otherwise the symptoms had so ameliorated that some of them could be brought out only after a long and patient examination, and the rest had to be accepted as a matter of history of the case. I had his photograph taken, and by comparing it with another taken several weeks previously his family noticed what was quite obvious in that light, but what had thus far been overlooked—namely, that the facial muscles had lost in expression. He is still living, in the last stage of general paralysis.

Case XII.—Also a clergyman, who had an exacting city parish, of the age and physique in which general paralysis prevails, was found by the more critical of his hearers to be, after ten years' service, not fully up to his work —a fact which at first was attributed to his long, steady service. It was soon seen also, that his judgment and common sense and notions of propriety fell slightly short of his normal standard. He was observed by his wife to be more easily irritated, slightly changeable and restless, uncertain in his emotional state, easily exhausted in mind and more readily tired by bodily work. He was less attentive than usual, hardly careless, perhaps almost indifferent

in the little affairs of daily life, and, finally, nearly five years ago, while in the pulpit, performing the rest of the service without fault except as above noted that he did not rise to his usual level of intellect and force, he read to the choir the same hymn three times for the different parts of the exercises, instead of three separate hymns, and did not himself notice the slip. These were all the material mental symptoms when I saw him four years ago.

Physically, the conditions were about as in the case just described, except that there were often dizziness and headache. The handwriting showed the same fault—that is, the first page was without obvious fault, unless minutely compared with his previous handwriting, but after many pages it was unsteady enough to make the difference distinctly appreciable. The diagnosis of general paralysis was made, and he was sent to absolute rest in the country for nearly two years. A letter written there with great care is not distinctive of itself, but as compared with his ordinary handwriting shows some deterioration. Perhaps it is most interesting as showing how well a general paralytic in the early stage can write.

He improved very much in the first month and then very slowly for a year, but without recovering his previous intellectual power or his emotional stability. His gait had become somewhat heavy, and the knee-jerk exaggerated. His face had lost animation and expression, he had to be careful in turning around quickly, going up and down stairs, and in getting up from a chair. He has taken a small parish where the demands upon him are light. When I heard from him in 1887, he was performing its duties without complaint, although the standard of his congregation did not make such demands upon him as his former city parish. His legs were still not entirely firm so that, if tired, his gait, always heavy, was sometimes unsteady. He also had less serious views of life and duty. His articulation was not thick, but he could not make himself heard so distinctly in a large hall, and the tone of his voice had changed a little, so as not to be so clear. He is still in the same parish.

Case XIII.—Mr. ——, seen three years and a half ago, a strong, robust man just under fifty years of age. For a little more than a year his wife had noticed slight inaptitude for business, very slowly increasing, although he still continued to manage his affairs without any serious mistakes. He had become emotional, easily irritated to explosions of anger, and slightly indifferent to her, as well as negligent and careless of little home duties. He was not inclined to exert himself mentally or physically, and when he did so he was easily tired, especially in his legs. The articulation was not changed except on close examination, and then only in quickness and flexibility of the labial and lingual muscles. There was a little lack of readiness in response, as well as a slightly diminished clearness in talking, such as is observed when one speaks with the lips moderately chilled in frosty weather. The diagnosis of the prodromal period of general paralysis was made. The gentleman gave up his business to his son, lives a life of leisure and quiet, and has made such slow progress downward that it is often quite possible to meet him and talk with him and not notice any defect in mind or body.

CASE XIV.—An express-delivery driver, who had slightly marked epileptiform seizures for five years before he became so forgetful of his orders, or unable to fix his attention on them, that his employer had to tell him that he was of no further use to the company. The convulsions were characteristic of general paralysis, and continued up to the time of my seeing him, when there were also other and unequivocal signs of that disease. The prodromal period in this case was nearly, if not quite, five years.

CASE XV.—Mrs. ——, forty-nine years old. Four years previous to my seeing her she began to consult oculists, and finally an ophthalmic surgeon, for asthenopia, and especially for difficulty of accommodation. No mental symptoms were observed, although it is fair to say that they were not carefully looked for until about a year afterward, when she had been exhausted by the physical strain and mental and emotional worry of the care of an ill mother and sister, and by her father's death; and these mental symptoms were not such as to cause anxiety or even much remark. A year later still, she began to have attacks of loss of consciousness, similar to petit mal, which occurred usually after she had been lying down for awhile, and for the most part after sleeping. She had several while standing, and came very near falling—thinks she would have fallen except for some support. She remembered much less well than formerly, forgot little things about the house, was irritable, apathetic, indifferent, disinclined to exertion. She was read to, but did not take in the full sense of what was read to her, or remember clearly what was read, although she could talk about the books in a general way. Her husband, on questioning, said that her statements to me were not entirely correct, and expressed surprise that she did not recollect better. He had noticed that she forgot where she put things, and that she would start off with the intention of doing something, which she would forget before she got to the room for which she had started. There was lessened life and ambition in her face.

Physically, there was great loss of strength, especially in the legs, particularly noticeable on going up and down stairs. After walking a half mile she became exhausted, and her gait unsteady and tottering. She had been dizzy at times, rarely had headache, and could not fix her eyes to read. The hands were tremulous. There was a little hesitation in speech, almost a rudimentary stutter, which, however, she and her husband, whether rightly or wrongly, thought natural. Her articulation was clearly deliberate, almost to the point of sluggishness. She had lost sixteen pounds in weight in spite of a good appetite and very hearty eating. I have not watched this case to terminal dementia, but have no doubt of the result.

CASE XVI.—Mr. ——, a druggist, thirty-eight years old, three or four years before I saw him, in December, 1886, began to show a want of aptitude in his work, which had been slowly increasing up to the time of my seeing him. He also had had moderate pains in his legs, and headache occasionally, for which he began to dose himself in a very foolish way, taking drugs almost at random from his shelves. He went to his business daily, and nominally attended to it, although he had excellent clerks, and there happened nothing strikingly amiss. First his family and his clerks, then his customers, observed what they

considered absent-mindedness and inattention on his part. His father-in-law, an intelligent wholesale druggist, thought he must be taking morphine. In July, 1886, without giving any reason for it, he stopped singing in the choir, of which he was the leader, and ceased going to church. He made constant false statements, which were thought to be lies, but which on examination I satisfied myself were due to confusion or impaired memory and attention. He was pliant, dull, apathetic, with lessened animation in his expression and conduct. He knew there was something wrong, but failed to comprehend the whole situation. As to physical symptoms, there were inertia and weariness on moderate exertion. He had lost forty-seven pounds in spite of a voracious appetite and abundant nutritious food. There was moderate tremor of the hands and tongue, but no more than is often seen in neurasthenia. His articulation was slow, and as described in the several cases above. He readily gave up his business, and went to a private insane asylum, where he has recently died with the classic symptoms of general paralysis fully developed.

CASE XVII. is of an athlete in the prime of life, engaged in mercantile pursuits. I know nothing of the initial stage, except that the patient had manifested an inaptitude for, or indifference to, his business and family and social relations, for which he had been sent away. He led a social life, rode horseback frequently and for long distances, and grew rapidly worse. His case is an excellent example of how far general paralysis may advance without producing such distinct motor symptoms as are ordinarily considered necessary to establish the diagnosis.

When I first saw the patient, in April, 1886, he was sitting quietly at his desk at home. He was calm, not quite as carefully dressed as usual, but with a slightly nervous manner. I learned that, on opposition, he became so quickly and so violently angry and excited that his wife and the servants were almost afraid of him. He also became just as easily weeping and pathetic, and he could be moved to one state or the other, and from one immediately to the other, at my will. Except when opposed, there was no motor excitement. His lips quivered a little, and there was the same diminished flexibility, if I may use the word, as I have already described in Case III., as regards the muscles of articulation. There was no evident ataxia, and all that I could get of his handwriting failed to show anything distinctive. He sat calmly in his chair, and said, very deliberately, at some points almost with a drawl, that he had discovered a way to make a fortune for himself and all his friends, which he should divulge to the stock exchange as soon as he had made himself and his family rich; that he should turn the guests out of —— hotel, cover the building from roof to sidewalk with jacqueminot roses, get a symphony orchestra there, invite the members of the stock exchange to dinner, and show them how to get rich. There was no motor excitement, and no rapid flow of ideas, as in mania. Indeed, he got out his ideas and his sentences with deliberation amounting almost to slowness. When told that he must go to the asylum, he made such vigorous opposition that the efforts of five strong men were needed to control him. He then immediately became pliant, readily yielded, and became tearful and pathetic,

but soon laughing, and with an evident failure to take in the full situation. After excluding ordinary diseases other than mental, and noting the absence of the rapid ideation and motor activity of mania, I regarded the mental state as pathognomonic of general paralysis. At the asylum to which he was sent a diagnosis of general paralysis was not accepted without the symptoms of the text-books, which were not present.

In November of the same year I saw him again with regard to removal to another asylum, as he associated noises near him with disagreeable persons who, he thought, were making definite disagreeable statements to him or of him in that way.

Physically, the knee-jerk was active, more marked than when I had seen him before. It was easier to get the quiver on his lips; there had been some progress in mental impairment, which showed itself most markedly in the way in which he did various things which I asked him to do. At the same time there was the diminished animation and force in his countenance of that peculiar quality which one sees only in general paralysis, and called, when more marked in a later stage, the "petrified face." But it was still some time later before such distinct motor and mental symptoms appeared as satisfied either the physician of the asylum from which the patient went or of that to which he was sent, that the case was general paralysis. He is now in the last stage of that disease.

In the case of a gentleman whom I recently saw, his partners in business observed that his portion of the work was not as well done as usual, that he failed to give the proper orders for renewal of stock at the proper time. Six months later his wife saw an entire change in his personal treatment of her, in that he had become grossly inconsiderate; later still, his near friends found that he had become less polite in his manners at the table, and quite selfish and self-absorbed. Then the children noticed that he was indifferent to them, and often unreasonable. At last the family physician was consulted, and he was sent on a personally conducted excursion, which he left without any obvious or stated reason, walking a number of miles to return home by another route.

When seen by me, he put his feet in the chair in talking, whistled occasionally, and in such little ways acted in a manner stated by his family to be quite unlike himself. He was indifferent and apathetic; several of his letters were shown me, and his writing was without conspicuous fault. His speech had the unmistakable deliberation and perhaps the faintest possible hesitation, which his family did not notice, but he articulated long words with many labials and linguals without stumbling. He became explosively angry when opposed or

restrained, violently resisted, and soon became pliant and easily managed. He had shown marked inattention to his business; his conversation was often inconsequent; no one could tell where he went when he left the house, and he often wanted to go without an expressed purpose; and yet he had done no one act especially out of the way. There was no delusion, hallucination, illusion, delirium, or dementia discovered. No definite muscular tremor or ataxia was apparent by any of the usual methods of examination, although there was the faintest possible impairment of articulation, which none of his family had noticed until their attention was called to it. They thought he might be a little slow of speech

It is usually difficult for friends to describe the earliest traces which they observe of general paralysis, and I have never yet seen a case in which they suggested any suspicion of disease to the friends or the family physician. A distinguished pianist lost his fine appreciation and nice touch, so that his conductor thought that he had fallen off in practice. A wife spoke of her husband as being the opposite of himself. A daughter said that her mother did not seem the thorough lady she had always been. One was described as seeming different from himself, the change being indescribable; one as a little slower in speech and gait; another as slow and indifferent in dressing, and apt to drop asleep; still another, as seeming well, but disposed to put useful papers in his waste-basket, etc.

A man who recognized his own condition, said that he had not good will-power; and an Irish weaver, when his wife and daughter were trying to describe his earliest changed condition, which seemed to them purely ethical, interrupted them by aptly saying that he had lost his presence of mind. A number of cases have been described by Goldsmith and others, where a violent epileptiform or apoplectiform seizure was the first recognized symptom of general paralysis; but, in my experience, such attacks, like the unexpected and often at the time unexplained offences against decency or the law, have always been preceded for a considerable length of time by the initial indications just described. So, also, in those cases where a violent shock or an accident appeared to be the beginning, the real beginning was much earlier.

Indeed, a purely symmetrical impairment, mental and physical, is most difficult to detect or describe, and may entirely deceive even the

physician, if he trusts to ordinary methods of examination entirely. A patient quite far along in the prodromal stage of general paralysis, was erroneously made the subject of a clinical lecture, as illustrating physical and no mental signs of general paralysis. Another went almost directly from the consultation-room of a distinguished neurologist, with a certificate that he was of sound mind, to make some most unwise and embarrassing contracts, and then, after the excitement and exhaustion of a long railroad journey, wrote a letter giving his friends much anxiety, and causing them to hunt him up at once and take him home. He performed his clearly irresponsible act in such a seemingly responsible way in all particulars that it would probably have been impossible to have it correctly estimated by the courts. He has since died, a typical general paralytic, with all the symptoms of the books.

To the etiology of general paralysis I can add nothing new. As is well known, it arises most commonly under conditions of prolonged strain, mental, emotional, and physical, especially if joined with unaccustomed high living and alcoholic and sexual excess, or after syphilis. The Irishman who lives in great deprivation at home, where syphilis also is said to be rare as compared with the rest of Great Britain, seldom has general paralysis; but, as a hard liver in the great cities of Scotland, England, and America, he has his full proportion. From five to nearly one hundred per cent. of general paralytics are reported by various observers as having previously had syphilis. Of Mendel's cases of general paralysis the percentage of syphilitics was seventy-five, and only eighteen per cent. in other forms of insanity—about four times as many; while Goldsmith found, by statistics collected in the Danvers Asylum, that six times as many general paralytics had previously had syphilis as the insane excluding general paralysis.

We must admit, I think, that taking into account self-deception of patients, and their conscious and intentional deceiving their friends and their doctor, at least two-thirds of general paralytics have previously had syphilis. If we assume, therefore, that one person in ten in a certain adult male community (from the age of twenty-one upward) has had syphilis, it appears that an individual having ever suffered from that disease has not far from twenty times as many chances of becoming a general paralytic as the rest of the community; and if the proportion should be one in twenty, the chances are respectively about

forty to one, and so on. This proportion is too large to be accidental, and yet there are two reasons, beside the purely numerical one, why general paralysis cannot be accepted at present, at least, as being a stage of syphilis, namely, because, first, the usual remedies for syphilis, as I read the evidence, are of not the slightest benefit; and, secondly, because there is no known method of certainly differentiating, either clinically or post mortem, those cases with and those cases without a previous history of syphilis. It goes without saying, that I exclude from consideration gross lesions of syphilis of the brain, of which endarteritis of the larger vessels is probably the most common, resulting in general cerebral degeneration, with symptoms somewhat resembling general paralysis.

To the pathology and morbid anatomy of general paralysis there has been no recent important contribution, unless we admit Meynert's theory, that preceding and causing the diffuse cortical encephalitis there is a functional vaso-motor disorder which he considers curable. His statement that the organic changes are marked, in point of time, by the patient losing the power to realize his condition, is not supported by experience.

The question whether the diagnosis of general paralysis can be made in its actual incipiency is still under judgment; I do not know an instance where it has been successful. Indeed, it is not within my experience that a physician has been consulted so early. The absence of subjective symptoms and the lack of those naturally observed by others, as compared with the various forms of neurasthenia, for instance, are quite deceptive. But the change in personal traits or character, and the peculiar apathetic, indifferent, unconscious quality of the mental impairment, in uncomplicated cases, are unlike anything else. There is not the slightest doubt, however, that general paralysis can be diagnosticated with certainty far oftener than not, for a considerable length of time before what is usual now.

It is quite true that the signs of mental impairment may be ascertained only by a painstaking examination, that the patient may bear cross-questioning without manifesting any degree of loss of those finer qualities of brain, psychic and motor, coming last in a highly organized and developed civilization, although it may at the same time be detected by the methods which I have suggested.

The very essence and nature of general paralysis imply and involve

mental symptoms in some degree, and some motor impairment, however slight, even if only judged by the test of a minute examination of what the patient can do and how well or how ill he does it.

The symptoms may thus be recognized in a large proportion of cases, and at least suspected in most, certainly in those persons whose brains are so highly organized, who are so trained and cultivated that slight changes in the highest brain centres produce distinct, although difficultly appreciated, departure from their normal character and quality of mind. In an orchestral leader, for instance, the mental and fine mechanical operations are so complex and of such high order that the least fault is detected; in professional and business men a less degree of impairment is recognizable than in mechanics; in routine employments without much thought or nice muscular effort, a large degree of deterioration may be unnoticed. In day laborers an early diagnosis is simply impossible.

The earliest signs of general paralysis are of the slightest possible brain failure; if, for instance, a strong, healthy man, in or near the prime of life, distinctly not of the "nervous," neurotic, or neurasthenic type, shows some loss of interest in his affairs, or impaired faculty of attending to them; if he becomes varyingly absent-minded, heedless, indifferent, negligent, apathetic, inconsiderate, and although able to follow his routine duties, his ability to take up new work is, no matter how little, diminished; if he can less well command mental attention and concentration, conception, perception, reflection, judgment; if there is an unwonted lack of initiative, and if exertion causes unwonted mental and physical fatigue; if the emotions are intensified and easily change, or are excited readily from trifling causes; if the sexual instinct is not reasonably controlled; if the finer feelings are even slightly blunted; if the person in question regards with a placid apathy his own acts of indifference and irritability and their consequences, and especially if at times he sees himself in his true light and suddenly fails again to do so; if any symptoms of cerebral vaso-motor disturbance are noticed, however vague or variable. Naturally there may be many or few of these indications in a given person. This group of symptoms seems very striking, but may be compatible with the performance of usual duties. They require careful and prolonged observation of the patient, and painstaking interrogation of his family and friends, for their detection. They are recognized perhaps as much from the pecu-

liar quality of the mental impairment, difficult to describe, as from its degree, and often antedate, at least in the time of their recognition, perhaps not absolutely, any physical symptoms, which, when they appear, may be so slight as not to be appreciated for a long time, except as an unusual sense of weariness on exertion, and perhaps attributed to malaria or rheumatism. Commonly there is loss of flesh—slight, moderate or excessive. A very great or disproportionate loss of physical power, especially in the legs, I have found to be due to a complicating peripheral neuritis.

We must not overlook the facts that there are elements of uncertainty in the early diagnosis of general paralysis, that there are few forms of mental disease in adult life that it may not simulate in obscure cases, and that it may be confounded with Bright's disease, epilepsy, hysteria, lead or malarial poisoning, cerebral syphilis, or the long-continued abuse of opium, alcohol, chloral, and the bromides, so that not seldom an absolute early diagnosis is impossible. But there is a peculiar, indescribable kind of mental impairment which, with the vague physical deterioration, if not obscured by other conditions, may be sufficient to decide the diagnosis. Even the expression of the face and the general appearance of the patient are often characteristic. There may or may not be slight confusion, a sense of fulness in the head, headache, insomnia. Except for unusual physical as well as mental fatigue following effort, the patient may feel entirely well and not complain of anything. There is no indication from the eyes or the reflexes so early; the muscular tremor is, as a rule, less than in functional nervous disorders; the speech may be not noticeably affected to the family, and may be only like that of a person with lips chilled by the frost or slightly under the influence of wine. It may be necessary to have the patient read or copy several pages or even be under close observation for several days before any defect is observed in the use of the muscles, or it may be necessary to test him in a new place or occupy him in unaccustomed ways.

Finally, perhaps the distinguishing feature of this stage of general paralysis is the fact that the change observed consists in a symmetrical mental and physical deterioration which, like all diseases in which a vaso-motor element is prominent, varies very much from time to time. It begins, or is first noticed, in those acts requiring the most complicated and highly coördinated effort, in the functions and powers com-

ing last in development of the highly organized and trained brain. As the mind becomes decidedly less able and the muscles less responsive, with less coördinating power, and finally weaker, the heavy and then staggering gait, the hesitating, stuttering, and finally unintelligible speech, and the progressive dementia, may be slow or rapid in their advance.

The prognosis of the pronounced general paralysis of the books is so unfavorable that there are only exceptional remissions of the symptoms which last so long as to justify a few writers in calling them cures. Early symptoms, however, which in men of forty years of age, so far as we now know, almost certainly mean death, when occurring in men of sixty are not incompatible with a fair recovery. In the stage of general paralysis which I have attempted to describe, it is true that there have been thus far only partial recoveries. But the indications are that a certain proportion of cures may be expected with more satisfactory treatment.

The treatment of general paralysis has thus far been most unsatisfactory from the fact that it is begun only very late; because a rest of a few months often brings such relief that further treatment is abandoned; because a remission which may naturally come in the course of the malady is too apt to satisfy the patient or the friends that the disease is at an end; and because our therapeutic measures have thus far proved, as a rule, so ineffective that we cannot often get our patients to consent to a great sacrifice of time and money, and all that goes with it, for a cure that at best may mean only comfortable uselessness for many years.

The travelling or stimulating life usually suggested ends in aggravation of symptoms. Entire mental rest in a quiet place in a sedative climate, with simple food, abundance of sleep and moderate exercise, result in such improvement that there is every reason to suppose that such measures, if fully carried out, might do more.

DISCUSSION.

Dr. R. T. Edes: I have been exceedingly interested in this paper, as it tends to settle several questions which have been in my mind for some time. The old notion was, that the disease was one lasting three or four years, and ending in death. That was due to the fact that the cases were not recognized

at anything like the beginning of their career. The falsity of this view has, however, long been recognized by alienists. I have for many years been interested in a case which is largely explained by this paper. The case is that of a man who had an excellent career as a young staff officer during the war. These facts have recently been inquired into with care. One or two years after the war he had a peculiar hesitation of speech, which, however, was not generally recognized at the time. I saw him many years later. Although his family was not well off, he wasted a good deal of money, and he seemed to be perfectly content to do nothing. That was the only symptom. For a long time it was considered that he was simply lazy. After a time, however, the symptoms became more pronounced, and his condition has for some years been such that any one would pronounce it general paralysis. I can recall something that looks like a beginning as far back as two or three years after the war.

If we accept the anatomical view, I do not think it strange that there should be cases where mental symptoms precede the motor. If general paralysis is an organic degeneration of the surface of the brain, creeping from one part to another, as seems to be indicated by adhesive meningitis, etc., it is not strange that portions of the brain affecting the mental condition are involved before the motor centres are implicated.

This paper is interesting and important as showing the necessity of a minute examination of the patient to detect the disease at an early stage.

Dr. S. Weir Mitchell: I had the misfortune not to hear the whole of this strikingly interesting paper. It struck me not more by the facts presented than by a certain charm of style of the communication. I have not a great deal to say upon the subject. I am quite sure that some cases of general paralysis begin most decisively with motor troubles, and that others begin most markedly with mental conditions such as have been described. I fancy that it is possible that, as Dr. Folsom has just suggested to me, some of these cases in which motor symptoms seem to be first noted, occur in people of high mental characteristics, who have such dominating control over their own symptoms that they can hide them away, but they cannot conceal the difficulties in their legs.

In regard to syphilis, I agree entirely with Dr. Folsom, except as to one thing. I am perfectly certain that I have seen cases due to syphilitic disease, and which neither I, nor any man whom I have called to assist me, could distinguish from typical cases of general paralysis, cured by specific treatment. I have cause to remember one such case. The history corresponded very well with the ordinary history of general paralysis. Unfortunately the man's wife was a little stupid, and the man was past bearing testimony. I decided that the condition was incapable of relief, and recommended that nothing be done. The patient was then taken to my friend Dr. H. C. Wood, who ordered large doses of iodide of potassium, and the man was practically made well.

I may say that I believe that I have seen a small number of cases of cures of this disease where it was taken in its very early stages, but where there

were enough motor disturbance and mental incapacitation to make me reasonably sure that the man would have developed general paralysis had time and circumstance allowed. I do not know of more than four such cases. I do not know of one in which the cure did not result from a total abandonment of previous pursuits, and the adoption of the absolute rest from work spoken of by Dr. Folsom. I agree with him that foreign travel is usually an injury.

DR. JAMES J. PUTNAM: This subject is of immense practical importance to the physician. There is probably no nervous disease, with the exception of locomotor ataxia, in which the early symptoms are so puzzling, and yet so important. Therefore, such a paper as this is very timely.

The mysterious connection, which I think no one can doubt, that exists between syphilis and these two degenerative diseases, which are also related to each other, I think justifies us in looking for other causes which might act in a similar manner. Syphilis apparently acts, not by producing a specific lesion, but in an indirect manner. I would ask Dr. Folsom whether he has met with any cases where chronic lead-poisoning had apparently had a similar effect. A case of this sort has been described by Oppenheim. This case was accompanied by an autopsy, and has been referred to as bearing upon the effect of lead upon the nutrition of the spinal cord. It was, later, referred to by Schultze, who doubted whether or not it was a case of lead-poisoning, because the symptoms were so like those of general paralysis. He states that he is not aware that any case has been reported in which such typical symptoms have been attributable to lead.

A few weeks ago, I saw an analogous case at the Massachusetts General Hospital. Before I saw him my assistant had made a diagnosis of probable general paralysis. He had imperfect and slow speech, impaired handwriting, and an expression of apathy and indifference which was very suggestive. The mental symptoms, however, did not appear to correspond. He suggested himself that the cause of his trouble was the use of drinking-water coming some distance through a lead pipe. This water contained offensive organic matter, and passed for a quarter of a mile through a lead pipe into a hogshead and was carried off by another lead pipe, both pipes lying permanently with their ends under the water. There were some local symptoms which suggested a diagnosis of lead-poisoning, yet the diagnosis of general paralysis would certainly have been a reasonable one.

DR. WILLIAM PEPPER: I think that it is fortunate that Dr. Folsom has read his paper here in an association of general clinicians, rather than in one composed entirely of neurologists or alienists. It seems to me that the points of chief importance in this remarkable paper—one of the most remarkable that has appeared upon the subject—are, in the first place, the large expansion of the idea of the early stage which one gets from this paper, and which, in view of the accuracy with which the cases are recorded, it is difficult to resist; and the curious variety of feature in this early stage, and the great extension of time in the duration of the cases. These seem to

me to bring the subject into such immediate relation with the every-day work of the clinician, that it makes it a matter of momentous importance to learn whether or not there really can be established positive diagnostic signs at this early period.

In reference to some of the minor questions—passing by the more important for the moment—I presume that many of us see these cases from a different standpoint from that of Dr. Folsom. They come to us for digestive troubles, lithæmic disturbances, and the like, and are under our care some time before they develop symptoms which lead to any suspicion of incipient paresis. I have had the opportunity of seeing these cases, sometimes for years continuously, before paretic symptoms make their appearance.

I should distinctly say, with reference to syphilis as a cause of general paralysis, that it cannot be regarded as essential in any way. In so many cases that I can recall—in a considerable proportion of which I knew the whole family conditions—all suspicion of syphilis has been positively excluded. If, then, we cannot connect with general paralysis any specific process which, once started, inevitably progresses until it produces fatal lesions, but recognize that various causes of constitutional depression and irritation may awaken individual proclivities to degeneration in some groups of cortical cells, we must regard all these irritating and depressing causes, eminently such as the ptomaine of lithæmia or lead-poisoning, as occupying almost the same standpoint as syphilis in regard to the development of this disease. It would also seem very clear that, if this is the case, there must be a stage in this change in the cells where it is capable of coming to a stop, and may not go on further, and even that in the early stage it may be entirely thrown off and complete recovery follow.

With reference to early symptoms, I think it is exceedingly important to recognize that they may occur as intellectual aberrations or mental defects, instead of as motor symptoms. I remember some striking cases of this.

As to the abrupt origin, adding simply to the large picture drawn by Dr. Folsom, I will mention a case under my care for a number of years with a form of nervous lithæmic dyspepsia. The first overt expression of the disease was that, while on his way to Asheville, N. C., whither I had sent him, he left the train before it reached its destination and wandered in the mountains for several days. He was found in a wretched condition, and brought home. After a protracted rest in bed he made an apparently fair recovery, which continued for almost a year. It proved, however, a mere remission in the case, for after that time the ordinary symptoms of general paralysis presented themselves and went on to a fatal termination. This case was under observation at least fifteen years.

Of course, we are all prepared to admit the exquisite delicacy of touch acquired by the diagnostician in his special field, largely due to his perfect familiarity with those indescribable changes, so slight but to him so appreciable, which enable him to distinguish in some subtle way a difference between the early symptoms of affections which to other physicians might seem wholly analogous. I daresay this applies to the diagnosis of the symptoms

of incipient general paralysis, as viewed in comparison with those of certain cases of lithæmia of the nervous type. It is a matter, of course, of enormous importance, for you are asked to make a diagnosis upon which the whole course of life has to be based—whether it is a remediable condition, dependent upon faulty nutrition, or whether it is the beginning of what has generally been regarded as a hopeless malady. I believe myself that in cases of lithæmia of this type, where the condition is not remedied and where there is any tendency to grave nervous trouble, the case will, if not correctly treated, sometimes go on to the development of general paralysis or of cerebral softening. But the point I desire to make is, that there are cases of lithæmia in which, so far as I have been able to gather from the paper of Dr. Folsom, almost, if not quite, all the symptoms mentioned by him as marking the very earliest stage of general paralysis may present themselves. The symmetrical disturbance of mental and motor functions, the curious loss of energy and apathy, and the changes in temper with explosive symptoms; the loss of fine touch in the performance of delicate operations, and even changes in their moral condition, may be present in a very striking degree, and yet we may see these cases, under suitable treatment, recover entirely. I wish to admit again that I see clearly that a diagnostic faculty, trained especially in the recognition of the incipient stage of general paralysis, may be able to distinguish with greater certainty the individual cases where the process is destined to go on to fully developed and fatal paresis. But the conclusion I am inclined to draw is, that in reality the process of general paralysis is one that can be initiated by many disturbing, depressing, or irritating causes, and that it is often a process which is preceded by symptoms largely lithæmic, which closely resemble the symptoms given as those of the earliest stage of general paralysis; and that by proper treatment, in a notable proportion of cases, these symptoms can be dispelled and the establishment of the process averted. I believe that the experience of the general clinician will show that if such cases are permitted to go on with the same neglect of hygienic laws, with excesses, sexual, alcoholic, or commercial, they will go from bad to worse, and will often end with typical symptoms of general paralysis. While, therefore, it is most important that such symptoms should be studied more and more critically, both by the general clinician and by the alienist, to learn the especial grouping or the particular features which establish the diagnosis positively at the earliest moment, it seems no less important that both the alienist and the general physician should recognize that there is in reality a much more favorable prognosis of this process in its earliest incipiency than the books teach. It is certainly an error to make a positive diagnosis, and base upon it a hopeless prognosis and abandon all thorough and radical treatment, as we not rarely see done, even when the symptoms would justify anxiety and suspicion.

Dr. Folsom: The cases reported, of course, represent only a comparatively small proportion of those that I have seen, and are related with the view of giving the most important points in reference to diagnosis. In

reading the paper, also, there are some parts which the limit of time compelled me to omit. I referred to lead casually as one condition liable to cause difficulty in diagnosis. I have seen a number of such cases. I have never seen a case precisely similar to those described by French writers under the head of pseudo-general paralysis from lead. I do not feel entirely sure that these are, in all respects, exactly reported. I have never seen a case in which lead seemed to produce the terminal symptoms of general paralysis, although it may produce the initial symptoms of that disease.

In regard to cure, I use that term as meaning the capability of the patient to return, at least approximately, to his previous methods and occupations of life.

I have seen quite a large number of cases benefited by large doses of iodide of potassium. They have, however, been of the following type, which also gives an illustration of a rather interesting point. A gentleman was sent to me some years ago, who had been treated in the best possible way for the primary sore and through the subsequent stages of syphilis. About two and a half years after he was supposed to be cured of syphilis he had a very severe hemicrania, for which he went South without benefit. When he returned, in addition to hemicrania he had the usual initial symptoms of general paralysis. Under large doses of potassic iodide he apparently made a complete recovery. He ret rned to his previous occupation, and did his work as well as ever. A few years later I found that the symptoms had, nevertheless, made regular progress, and I have no doubt what the result will be. Whether or not this is the course of all of these cases, I cannot say. It has happened to be such in those which I have seen.

TETANY.

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VERY few observations have been published in America on the extremely interesting disease commonly known as tetany. Drs. Henry Hun, of Albany; Carpenter, of Pottsville; Lyman, of Chicago; and J. Lewis Smith, of New York, have each reported one or more cases. It has been my fortune to have observed a large number of cases in Vienna during the winter of 1883 and 1884, and to have had under observation during the past three years a case which presents many points of exceptional interest. I will first give a brief description of the clinical course of this case.

The patient is a male, aged thirty-nine. His complaints when he first came under observation were *diarrhœa* and "spasms of the face, arms, and legs." He has been troubled with diarrhœa for ten years, and with spasms of an intermittent character for the past eight years. During the late American civil war he served as a private soldier in a number of the Virginia campaigns. During this period he had several attacks of malarial fever, and for a period of eighteen months he suffered from a mild form of chronic diarrhœa. He never had either syphilis or rheumatism, and never drank to excess. The family history is unimportant.

The patient is tall, emaciated, and anæmic, with an anxious, careworn expression. For the past eight years he has been troubled with the attacks of tetany. Usually the first subjective symptom of their appearance is double vision. Then the thumbs become strongly adducted and opposed, while the fingers are adducted and semiflexed. These contractions gradually increase in severity day by day up to about the tenth day, when they somewhat suddenly begin to decline, and the parts become normal twenty-four hours after.

When the attacks are what he calls severe, the adductors of the upper arm become involved, bringing the arms crossed in front of the chest, with the forearms semiflexed. For some hours before and during the whole period of tetany he has a disagreeable feeling of numbness in his fingers. The dorsum of the hands swell and they are extremely painful. The pain is especially

severe when an attempt is made to straighten the contracted muscles. The muscles of the face are also frequently the seat of contractions, the upper lip being usually drawn to the left and upward, and the lower to the right and downward. The facial muscles are also the seat, during the period of tetany, of fibrillary twitchings. The muscular contractions only occasionally affect the muscles of the lower extremities. When affected, the feet and toes are in a state of plantar flexion, the feet being turned inward and the thighs adducted.

The galvanic irritability of the nerves is found to be greatly exaggerated during the period of tetany. The following may be taken as an average result:

	Normal period.	Tetany period.
Facial	3.00 m. a.	0.25 m. a.
Radial	5.00 "	1.00 "
Median	4.25 "	0.50 "
Ulnar	3.50 "	0.50 "

During the period of tetany usually galvanization of either facial produced lively contractions on closing the kathode with a measurement of not more than 0.25 of m. a., while after the attack passed away it was necessary to employ 3 m. a. to induce a similar contraction. An anode opening tetanus is readily induced by a strength usually not exceeding 3 m. a. A strength of current necessary to induce a contraction during the quiescent period was sufficient in the tetany period to cause a distinct tetanic contraction. There were never noticed any signs of the reaction of degeneration, the KSZ. being always found more marked than the AOZ.

The difference between the reaction to faradization of the muscles during the normal and tetany periods is not very marked. In fact, the interossei require a much stronger current to induce their contraction during their tetany state than after it has passed away. This is no doubt owing to the œdematous tissues increasing the resistance. The mechanical irritability of the muscles when in a state of tetany is greatly exaggerated. The same holds true of the nerves innervating the affected muscles. Pressure on the vessels does not appear to increase the intensity of the muscular contractions. The muscles, although flabby, are in a fairly nourished condition.

During the period of tetany, the knee-jerk is greatly exaggerated, but after it has passed it is always difficult, and at times impossible, to induce contraction of either quadriceps when the patellar tendons are percussed. The same holds true of the biceps and triceps reflexes. There is nothing definite to be made out in regard to any of the superficial reflexes.

Vasomotor phenomena are frequently noticed. Mention has already been made of the swelling of the back of the hands. Herpetic eruptions on the fingers are occasionally seen also.

The tongue is constantly found in a raw-looking state.

During the intervals of freedom from the attacks, he suffers from diarrhœa, which moderates when the tetany makes its appearance. The stools are copious, semi-fluid, frothy, and look like pea-soup. The abdomen is usually distended. During the attacks, the urine has a high specific gravity from an

excess of urea. It contains also a great excess of indican. It is free, however, from both albumin and sugar. Jaundice frequently is present; there is no other evidence, however, of disease of the liver.

The spleen is normal in size. An examination of the blood reveals nothing abnormal. No evidence of any thoracic disease.

About one year after this patient came under observation, the following additional symptoms were noticed:

A complaint, not only during the attacks, but also in the intervals, of general numbness. There is noticed a difficulty in speech. He is able to articulate well, but on attempting to answer a question, it takes him some time to do so, and when he begins to speak, especially if any thinking is necessary, the speech is slow. The œdema, which was formerly confined to the back of the hands, is now more or less general, but is especially marked in the face. There is no pitting of the tissues, however. There is no trace of the thyroid gland. The anæmia has also increased in intensity.

These symptoms resemble closely those of myxœdema. Against that assumption we have the fact that there has been no progress whatever during the past two years, and this is hardly compatible with what is known to be the clinical course of myxœdema. At one time it appeared as if we were going to have a myxœdema engrafted on a tetany.

The case is undoubtedly one of tetany, but whether we have in addition myxœdema, or not, time alone will tell.

Steinheim, in 1830, was the first to give a true clinical description of tetany. Corvisart, in 1852, was the first to propose the name by which it is now universally known. It is, however, mainly to the observations of Trousseau, Erb, N. Weiss, and others that we have been made acquainted with many of the more important features of this remarkable disease.

There are three distinct forms of this disease—forms which differ, in the causes that give them origin, in their course, and in their prognosis, but little in the clinical pictures which they present. By far the most common variety of this disease is what is known as rheumatic or epidemic tetany. On the continent of Europe, especially in Paris and Vienna, distinct epidemics occur. In Vienna hardly a winter passes without such an occurrence. In the winters of 1883 and 1884 a very severe epidemic occurred in the latter city.

The course of the disease when it occurs as an epidemic, is acute—usually not lasting over two or three weeks—fatal cases being very exceptional. Extensive epidemics occurred in Paris in the years

1855 and 1876. In England and America no epidemics of this disease have been described.

A second variety of tetany, which is more chronic, is due to either chronic diarrhœa, prolonged lactation, or other debilitating influences. Except in being more chronic, this form differs but little from the epidemic variety. Recovery nearly always occurs. A third form of tetany follows the removal of enlarged thyroid glands. A very considerable number of cases of tetany following this operation are now on record. Up to May, 1883, Billroth performed 78 operations for the removal of enlarged thyroids, and in 13 tetany followed in the course of a few days; 6 of these 13 cases proved fatal. Two of the fatal cases ran a course of upward of one year, while the remaining four terminated within two weeks.

There is a very marked difference between the course of tetany following extirpation of the thyroid and that due to debilitating and epidemic influences. The former is a much severer type, being frequently fatal, while the latter is seldom or never fatal. A fourth variety of tetany is also distinguished by its fatal tendency. I refer to that which occurs in cases of dilatation of the stomach. Kussmaul, Gerhardt, Dujardin-Beaumetz, Müller, and others, have reported such cases. Müller has collected eight cases of tetany occurring during the course of dilatation of the stomach, with a mortality of sixty-six per cent. Judging from these statistics, tetany due to this cause is even more fatal than that arising from removal of the thyroid gland. I have purposely excluded the consideration of what is commonly called infantile tetany, as it appears to me that true tetany is an exceptionally rare disease in infancy. If we are to include, as many observers do, all cases of carpo-pedal contractions under the name of tetany, the disease is much more frequent among children than adults. Clinically there is a marked difference, however, between the carpo-pedal contractions so frequently seen in conjunction with laryngismus, and tetany.

1. The tetany of adult life is essentially an intermittent disease, while in the so-called tetany of infant life the contractions are permanent until recovery takes place. They may be more intense at one time than another, but they never completely disappear.

2. The carpo-pedal contractions of infancy appear in a very considerable number of cases to be due to cerebral causes, as eclampsia is

a very frequent complication. There is no doubt that true cases of tetany do occur in childhood; what I wish to lay stress on is, that they are very rare, and that it is an error to say that every case in which we have carpo-pedal contractions is a case of tetany.

Experimental Tetany in Animals.

When the thyroid gland is removed from cats and dogs, a series of symptoms set in in a few days, to which the name of experimental tetany has been applied. The first symptom usually noticed is a peculiar appearance of the eyes, due to a pushing forward of the membrana nictitans on the inner and under surface of the bulb, from tetanic contraction of the internal eye muscles. Simultaneous with this contraction of the eye muscles, there appear fibrillary tremors of the muscles of the extremities and face, and occasionally of the tongue. In some cases these tremors are so marked that it is impossible for the animal to stand erect, at other times they are so weak that it is with difficulty that they can be perceived. In addition to the fibrillary tremors, there is tetanic contraction of the muscles of the extremities. The muscular phenomena described alternate with periods when the animal remains quiet. The respirations are frequent and superficial. The temperature is not increased.

In most animals, after the eighth day, a suppurative catarrh of the conjunctiva sets in, which finally leads to implication of the cornea and its perforation. The death of the animal soon follows, either suddenly from tetanic contraction of the glottis or diaphragm, or more slowly from exhaustion.

In a very large number of thyroid removals in dogs, Fuhr was unable to find any constant changes in the internal organs. Neither the brain nor spinal cord presented any marked changes. The tissues in the neighborhood of the thyroid gland were carefully examined and were found normal.

Exceptionally, a dog may live after complete removal of the thyroid gland. Rabbits, on the other hand, usually recover from the operation, although liable to be affected by the muscular contractions. Man appears to stand midway between these two classes of animals, so far as his power of withstanding the removal of the thyroid is concerned.

The symptoms detailed as following the removal of the thyroid in the lower animals bear a striking resemblance to tetany as it appears in man; that they are essentially the same disease is extremely probable. A valuable proof of their identity has been pointed out by Schwartz. In all his cases—six in number—he found that both the galvanic and faradic reactions were greatly increased. The reaction of the peroneal nerve to galvanism was so marked that he often found muscular contraction induced by a strength of current not measurable by our ordinary clinical galvanometers; AOTe. and KsTe. were readily brought out by a very weak current.

Of the many different forms of cramps that affect the muscles in man, tetany is the only one in which there is a marked increase in the electric irritability of the nerves, with the possible exception of Asiatic cholera. Its presence, then, is of great diagnostic importance, and leaves little room for doubt that the muscular contractions which follow the removal of the thyroid in animals are of the same nature as those which follow a similar operation in man, and also similar to the same disease that occurs epidemically, and from the other causes already mentioned.

The Morbid Anatomy of Tetany.—In the few cases where a histological examination of the nervous structures has been obtained after death, no lesion to account for the symptoms present during life could be discovered.

The slight changes described by Weiss as having been found by him in the cervical cord are considered by all later observers as negative, a few swollen ganglion cells being the only abnormality described by this observer. Langhans found a periarteritis and periphlebitis in the white commissure and anterior horns of the cervical and lumbar enlargements in a woman who died at the age of forty-eight, after having suffered for some time from tetany. Similar vessel-changes are, however, not infrequent at this age, and, therefore, cannot be taken as in any way distinctive of tetany. Schultze and Beyer have each had in several cases opportunities for making a thorough examination after death of the central and peripheral nervous system, and with negative results in every case.

We may therefore conclude that, as far as we know at present, there are no anatomical lesions in cases of tetany. The same is true of the tetany induced in animals by removal of the thyroid gland.

Judging from the clinical course of the disease, these negative results are what we would naturally expect.

Before discussing the probable nature of the disease, it will be in place to glance at the present expressed opinions as to the cause of the experimental tetany of animals after removal of the thyroid gland. With but very few exceptions, every recent experimenter in this field has arrived at the conclusion that the tetany is directly brought about by the removal of the gland itself, and that it has nothing whatever to do with injury of the nerves in the neighborhood. The very recent experiments of Fuhr, Weil, and Schultze establish this, I think, beyond doubt. An interesting experiment performed by Fuhr shows that simple irritation itself does not bring about any of the symptoms of tetany. He injected a hypodermatic syringeful of a ten per cent. solution of nitrate of silver between the gland and its capsule; severe and extensive inflammation of the gland and neighboring structures followed, but at no time were there present any fibrillary tremors, muscular contractions, or other symptoms indicative of tetany.

It is a well-established fact that the removal of one gland does not bring about tetany, but if, after the wound is completely healed, the remaining gland is removed, the symptoms of tetany quickly develop, and we then have the usual lethal course as seen when the two glands are removed at the same time.

Weil has also shown that if a portion of each gland is removed the result is negative, while the usual symptoms quickly make their appearance when the glands are completely removed.

I think there can be no other conclusion after the consideration of the above facts, than that the cause of tetany in animals is due directly to the removal of the thyroid glands. And no other conclusion is tenable in regard to the tetany which follows extirpation of the thyroid in man.

As the removal of the thyroid glands, both in man and animals, brings about a certain train of nervous symptoms, it follows that these glands have some important relations to the nutrition of the nervous system: whether this function consists in the removal from the blood of matters which would be injurious to the nervous system if allowed to circulate it is difficult to determine. Experiments performed by Ewald, of Strasbourg, lend great probability to this view. He in-

jected a number of dogs with the freshly expressed juice from the thyroid glands of healthy dogs, and invariably found that the animals became soporose and cataleptic.

To explain how causes, seemingly so diverse in their operation, as rheumatic influences, diarrhœa, pregnancy, lactation, and removal of the thyroid glands, can induce similar symptoms is very difficult. The active cause in the case reported is, no doubt, in some way due to the diarrhœa, but is the disease induced through impoverishment of the nerve centres, or through the peripheral irritation, or from the absorption of putrid products?

It appears reasonable to conclude that in all cases of tetany we have to do essentially with an unstable condition of the nervous system, a condition which readily reacts to slight peripheral influences. In the great majority of cases the disease is connected with some directly debilitating cause.

No doubt peripheral irritation is an active factor in a considerable proportion of cases. Müller reports two cases of tetany occurring in simple dilatation of the stomach, and where, after death, this organ was found to be twisted on its axis.

I am unable to advance any facts as lending probability to the view that tetany is brought about by the absorption of the products of putrid decomposition.

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TETANY; A NEW THEORY OF ITS PATHOLOGY.

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I. It is my intention, in view of the fact that the general subject of tetany will be presented before this meeting in another paper, to confine my discussion to its pathology. And I do this the more willingly, not only because I shall avoid repetition before this Association of what will be so ably presented by another, but also because I desire to furnish for your consideration, as far as I am able, an original pathological study, which may be best discussed apart from matters which pertain to other branches of the subject.

A brief allusion to the literature and history of tetany may, however, be permitted by way of introduction.

Tetany, as a recognized *disorder* (and I prefer this term to that of *disease*), dates from the memoir of Dance, published in 1831, in the *Archives Générales de Médecine*, and entitled "Observations on a Form of Intermittent Tetanus." The attention of the French physicians of this period having been directed to the new malady, various papers and memoirs were contributed by them, bearing date from 1832 to 1855, in which several new names were given to the neurosis. Some of these express the special pathological view taken by the author, *e.g.*, rheumatic contraction occurring in nurses (Trousseau); intermittent tetanus (Dance); idiopathic muscular spasms (Delpech). Of other titles, conveying no necessary theory, that which has prevailed finally is tetany, proposed by Dr. Lucien Corvisart in 1852. To this designation there can be no valid objection, and it calls attention to a marked feature in the symptomatology, viz.: that there is, by reason of extension of the muscular contractions to the muscles of the jaws, a superficial resemblance to idiopathic tetanus.

Among recent writers on tetany, in other nations, may be mentioned

Buzzard and Gowers, of England, and Berger, Erb, and Eichhorst, of Germany; but it may fairly be conceded that no advance in our knowledge of this disease has been made since the writings of the French school, and especially since the classic lecture of Trousseau on this subject.

II. Tetany is, perhaps, best defined as a nervous disorder, accompanied by tonic spasms of an intermittent character, which extend from the extremities to the muscles of the jaws, and which may be reproduced during the period of intermission, at will, by compressing the affected parts, either in the direction of their principal nerve-trunks, or over their bloodvessels, so as to impede the circulation. But this descriptive definition does not go beneath the surface. It does not deal with the underlying pathology of this disorder, which up to the present time has not been definitely determined. Indeed, according to Lyman, the "later observers, particularly Berger, in the German *Encyclopædia of Medical Sciences*, and Eichhorst, take the ground, pretty strongly, that there is no definite lesion connected with the disease." No definite lesion, perhaps, but may there not be a definite cause, connected with many lesions, or with some one of many lesions? Is tetany a special disease, or a sequel of precedent phenomena only? Is it an independent morbid entity, or a consequence of some other diseased condition of system? Should it be considered as itself a disease, or (as I have already intimated) be classed among the disorders liable to occur under the influence of a precedent morbid state?

This question can only be answered by an analysis of the conditions and circumstances under which tetany has been observed. These have been many and various. It has been noticed that diarrhœa has very frequently been a condition. But so, also, has constipation. The post-puerperal state and lactation in women have been frequently noted. But children and adult males are also subjects of tetany. Typhoid fever and phthisis have furnished a number of cases. So has exudative disease of the pharynx. Can we make any generalization among all these varying conditions? Can we make clearly evident any fundamental peculiarity among all these different morbid states? I believe this can be done. Such a study has led me to the conclusion that the well-known general condition of systemic infection called sepsis, can be safely asserted, and surely proven, to underlie or accompany every antecedent disease that has been observed to be connected with tetany.

In other words: *Tetany, as a general rule, follows upon such diseased conditions of the system as are observed to produce morbid discharges from mucous surfaces, whose absorption is known to cause symptoms in remote parts of the body, due to the circulation of septic poison.*

I have now to speak more in detail of some of the most frequently noted antecedent diseases, or morbid conditions connected with tetany.

And first, may be named the post-puerperal state. Trousseau calls this an intermediate condition between health and disease, but it is more. It is more frequently a state of disease due to septic inflammation of the generative tract. Modern obstetric physicians believe that sepsis is usual at this period. To its influence they justly attribute the so-called "milk-fever," the puerperal inflammations, and many other of the disorders of puerperal women. If, then, a septic condition may, and often does exist, sufficient to cause these disorders, it is not difficult to see that it may readily account for the appearance of tetany in the post-puerperal woman. This explanation, of course, will include cases of tetany among wet-nurses, in lying-in hospitals, where it was so frequently observed that one of the names bestowed upon the disorder was "the rheumatic contractions occurring in nurses."

Next to the post-puerperal state may be mentioned diarrhœa, and especially when chronic. It is almost unnecessary to advert to the conditions of putrefactive and septic intestinal catarrh as competent to produce systemic infection by absorption; and, consequently, any of the so-called septicæmic results. In my own experience in the Civil War, such results were frequent, and septic poisoning from chronic diarrhœa was fully recognized by army surgeons. Certainly, then, tetany may well occur after chronic diarrhœa, if tetany be a result of sepsis. Bearing immediately upon this point, Trousseau records "many cases in individuals who had suffered from cholera."

Demarquay and Delpech have recorded some instances which were observed after the septic diarrhœa of typhoid fever.

Thirdly, tetany has been noticed where the precedent condition was that of chronic constipation. Such a case has been recently published by Dr. J. Lewis Smith (*Medical News*, August 31, 1889). But we all know that in many instances constipation is attended by catarrhal inflammation of some part of the intestinal mucous membrane, or even by putrefactive changes in the food, resulting in production of poisonous alkaloids, which by absorption will result in serious septic infection.

Fourthly, certain cases of phthisis have been observed to precede the development of tetany. In this event there is no difficulty in the supposition that the septic poisoning which is competent to produce "hectic fever," may be equally effective in causing conditions favorable to the development of the disorder which we are now studying.

To sum up: *In all recorded observations of morbid processes antecedent to tetany, a probable sepsis may be inferred—and no other cause, common to them all, has so far been discovered. To this fundamental peculiarity, therefore, must be assigned the causation of the final result, tetany, as a disorder consequent.*

III. I will now attempt to illustrate by cases the connection of septicæmia with tetany.

CASE I.—Cecil D., æt. thirteen months, was seen September 29, 1883, for an (apparently) poisoned wound near the hip-joint. An area of inflammation over a hardened base was found; pain and fever were noted. In a few days a small abscess was opened, and thin sero-pus escaped. Under antiseptic measures this healed readily enough, but nervous irritation persisted in spite of sedative treatment. Soon a tonic spasm affected the eyeballs, fixing them and directing them to the right. The left arm and hand were contracted typically, the flexed thumb and fingers closed over it being fixed in the position of the so-called accoucheur's hand. No ordinary convulsions occurred, nor was there loss of consciousness. Some relief was obtained by the use of chloral. Later in the day, however, the eyes were again contracted by tonic spasm, but were drawn in the opposite direction—to the left, instead of the right—and now the right arm became involved. Some difficulty in administering remedies made me discover that the jaws could not well be opened. On the third day this state of affairs was much worse. There was alternation of tonic spasm, first upon the right side and then upon the left side of the body, in a curious manner, with completely locked jaws. I relaxed the contraction by chloroform inhalation sufficiently to allow the introduction of wedges of soft pine wood between the jaws; and to my great surprise the entire spasm relaxed. The pressure of these contracted muscles upon the wood seemed to exhaust their contractility. The eyes became straightened, and all muscles relaxed. Relief was, however, only temporary. The spasms returned. No treatment availed to stay the progress of the disease, and death ensued in about a week from exhaustion.

In this case the whole train of symptoms must be traced to the abscess. The child was previously perfectly healthy and its surroundings unexceptionable. No local results could be found. The abscess healed, but septic material had been absorbed, and tetany

followed. There is absolutely no other possible explanation of this case.

CASE II.—Sophia S., aged eleven months, was seen September 29, 1880, and underwent an attack of scarlatina. Septic poisoning was incurred, in the course of the disease, from foul secretions in the throat. Purulent effusion into the right shoulder-joint followed. I opened the joint freely and evacuated a quantity of sero-pus. Under antiseptic management the wound healed kindly, and the joint was restored to usefulness, but nervous symptoms persisted. Restlessness, twitchings, and, finally, laryngeal spasm ensued. A fit of crying would bring on a paroxysm of "crowing croup," and fits of crying were not infrequent. The muscular contractions of tetany were then observed, and at first were mistaken for ordinary convulsions, but as the spasms were tonic and not clonic spasms, it is evident that their true significance was not recognized by me at that time. The child eventually recovered, but for several years afterward was liable to attacks of tetany from very slight causes, such as taking cold, or when suffering from ordinary diarrhœa, during subsequent teething.

Any comment upon this case which would attempt to ignore the principal part taken by the blood-poisoning in the production of the tetany would be entirely unsatisfactory and illogical.

If this case teaches anything, it is that tetany is a disorder consequent on previous disease, and that sepsis sufficient to cause purulent effusion into a joint can also produce tetany.

CASE III.—A little girl, twenty-one months old, recorded by Trousseau. Symptoms observed were œdema of the feet and limbs, with the contractions of tetany very well marked. The child was of weak constitution, and was suffering from membranous, ulcerative stomatitis. The exudations, which were of a grayish-white color, extended over her tongue.

In this description we recognize a condition of vitiated and septic secretions, in which every opportunity exists for absorption into the blood of the material poison which I have assumed to be the efficient cause of tetany.

With these cases I will close this direct argument and pass to other indirect and corroborative reasons why septic infection may produce tetany.

IV. For, in a general way, it may be shown that many other nervous affections do directly follow sepsis; and it may be deduced that tetany is not unlikely to be in the same category.

The following case, in which laryngismus stridulus occurred after a

surgical procedure, which unfortunately ended in septic disease, will be to the point:

CASE IV.—E. A., aged about six months, was operated on for a very extensive erectile tumor of the scalp, which seemed rapidly increasing. Hemorrhage being feared, ligation was done under chloroform. Strangulation was not perfectly accomplished, owing to the size of the tumor, and death of the parts proceeded slowly. Erysipelas was soon observed in the scalp, around the ligatures, and the tumor was immediately removed by the knife, and dressed antiseptically. Infection, however, had taken place. The left shoulder-joint became widened, the superficial veins enlarged, and fluctuation was evident in the synovial sac.

I opened the joint, washed out the contents, and treated the wound antiseptically. A perfect cure resulted, with restored motion of the joint. But nervous disorder was left. Restlessness was extreme, and the child became the subject of severe laryngismus stridulus, which came on after the least distress or fright, or even after a crying spell. This, though alleviated by every device and every attention possible, remained through life—the little sufferer dying eventually of malignant diphtheria.

The remarkable resemblance between this case and Case II. will be noticed. Sepsis after scarlatina, and after a surgical operation equally produced purulent effusion into the shoulder-joint. The final result in one instance was tetany, in the other laryngismus stridulus.

CASE V.—Leonard F., æt. twenty-eight years, sustained a fracture of the clavicle. From neglect and mismanagement, secondary abscesses occurred under the axilla. I was called to see him for a violent attack of chorea, which set in after the evacuation of the pus from the axillary region. This chorea was attended with disturbance of the higher nerve-centres, as shown by delusions, irrepressible attacks of rage, and other symptoms of acute mania. Entire recovery in about seven months took place.

I will not cite any other illustrations of the fact that serious nervous disorders may follow sepsis. It is sufficient to call attention to such ordinary medical facts, and to reason from analogy that it adds weight to the probability of my theory of tetany.

V. It may have occurred to many of us, since the investigation of tetany has been attempted, how rare a disorder it is. Ten years ago it was not common, twenty or thirty years ago it seems to have been almost an ordinary affection. What is there in the diarrhœas of the present day which has hindered the development of tetany as a sequel? Is it not because we recognize intestinal sepsis, and make antiseptic medication our principal treatment—resorcin, sulphocarbolate of zinc,

creasote, and other antiseptics so modifying the intestinal secretions that a septic poisoning from diarrhœa is now an exceptional result?

And so with all the other diseases—antiseptic measures have been so thoroughly employed in treatment, both in obstetric and surgical cases, that septic poisoning promises to become almost a memory of the past.

The diseases which furnished Trousseau, in the hospitals of Paris, his opportunities for the study of tetany, are now so modified as to neutralize or destroy the septic element which ordinarily accompanied them.

With the extinction of septicæmia, will come the disappearance virtually of septic disorders and sequelæ, and among them of tetany itself. Just as puerperal inflammations have gradually been less and less frequent, under the rise and the perfecting of antiseptic midwifery, so with tetany. And this is to my mind the most convincing proof of the correctness of the pathological considerations which I have had the honor to lay before you.

VI. It remains only to mention the insufficiency of pathological views which were previously advanced.

The rheumatic theory is manifestly inadequate. It neither meets the cases of typhoid, phthisical, or post-puerperal origin. And in rheumatism itself a septic condition may occasionally be generated.

And so with other views—no one of them being a generalization sufficient to include what we know of the antecedents of tetany.

DISCUSSION.

Dr. Fracnis P. Kinnicutt: A very interesting point in Dr. Stewart's paper is the possibility of the coexistence of the two diseases, myxœdema and tetany, in a case where there was an apparent absence of the thyroid gland. The peculiarity of the œdema described by Dr. Stewart in his case is an œdema more or less general, but most marked in the face and hands, and of the hard variety; the deliberation in speech which he mentions, not a difficulty of articulation, but that peculiarity which we recognize in myxœdema (the patient wishes to speak, but it is some time before he is able to do so) is very characteristic, and seems to point quite positively to the existence of a myxœdema in addition to tetany. The non-progress of the symptoms in the course of ten years does not militate against the supposition of a myx-

œdema, as marked intermissions, and even temporary improvement, are common in this disease. I have at present two cases which have been under my observation for five years. In one, the condition has not materially advanced during that time. In the other, there has been most marked improvement at times, so much so that the possibility of error in diagnosis was suggested. The symptoms have, however, lately increased to such a degree as to demonstrate the correctness of the diagnosis.

I have seen two cases of intermittent tetany in connection with great dilatation of the stomach. In one case the dilatation was due to pyloric stricture, non-cancerous in character; in the other to malignant stricture of the pylorus. In both cases the conditions favored the absorption of poisonous matter.

Dr. F. T. Miles: I recently officiated at a fatal case of tetany in a woman, twenty-two years of age. She had suffered for six or eight years with dilatation of the stomach. She had vomited matters of an acid character, but never offensive. Digestion was poor and emaciation extreme. She had, on several occasions, felt a numbness about the fingers and toes. She was seized with an attack of tetany, with the classical position of the hands and feet, the contraction about the face and mouth, and the fixed rigidity of the eyes. This attack occurred about twenty-four hours before death. I observed that during death she did not become cyanosed. She did not die from spasm of the respiratory muscles. She was bathed in profuse sweat, and the face was very much flushed up to the moment of death. There was no relaxation of the position of the fingers and toes after death. The following day, when I made the post-mortem, they were still in the position of tetany. The post-mortem went only so far as to examine the stomach, which was largely dilated as a result of non-malignant stricture just beyond the pylorus. In this case offensive matters had never been vomited, and the stomach had never been washed out.

Dr. A. Jacobi: In spite of what we have learned to-day of the nature of tetany, I believe that a number of questions still remain to be solved. There are a few points to which I should like to call attention. One is, that we should not apply the name of different conditions in the adult and in the child. Dr. Stewart has claimed that tetany in the latter has been called a condition of permanent or persistent carpo-pedal contraction. That, I believe, is not so. This condition of persistent carpo-pedal contraction has been described by different names, particularly by the French, as contracture, or arthro-gryphosis, etc. As far as I know, tetany has been applied to an intermittent contraction only such as that described by Dr. Stewart. The disorder is certainly the same in the child and in the adult.

It has struck me that the two gentlemen lay great stress upon sepsis. Dr. Stewart considered that in his case of dilatation of the stomach the probable cause was absorption of putrid material. He adds, however, that the stomach was twisted. I should suggest that this intermittent contracture was due rather to nervous influences resulting from the twisting, than from absorption

of putrid material. I have not the slightest doubt that there must be cases in which absorption of putrid material will give rise to such symptoms, but when we have the fact that the contractures are temporary, we should have to conclude that the cause giving rise to the special attack was temporary too. There are a certain number of symptoms which we call epilepsy. When epilepsy is due to the presence of a tumor or an external cicatrix, we still require something additional as the proximate cause, that the attack of epilepsy may make its appearance. If this were not so, why should we not have the attacks of epilepsy constantly? Thus, we must say that we will have the proximate cause of the attacks of tetany in a nerve irritation, beside a possible fixed and permanent cause. The cases related by Dr. Carpenter also appear to prove this. He speaks of chronic diarrhœa and constipation giving rise to tetany, and concludes that it must be because there is absorption. I should say that it might just as well be the result of nervous irritation, as we know a man who is despondent and depressed may be relieved entirely by a movement of the bowels. We should not say that all at once the absorption of putrid matter has stopped and the brain relieved. The relief is certainly the result of alteration of the abdominal circulation. We should not assume septic absorption in such cases.

In the cases of scarlet fever and removal of a tumor from the scalp, etc., in which it was believed that sepsis must have been the cause of tetany, I should conclude that anæmia was the original cause. The children were run down considerably, and I should say that the condition in both children was anæmia. Anæmia, particularly in children and infants, in which the irritability is very great, and in which the inhibitory centres are very insufficiently developed, often predisposes to convulsions. One of the doctor's cases was not one of tetany. General spasms occurred a number of times, involving all the extremities and ending in death.

I believe that we should look for the cause of this disorder in a number of different conditions. In a few cases lesions of the meninges and spinal cord have been found. In others, nothing has been found. Anæmia has been found in many. Early age is present in many cases. Exhaustion in many. I believe that we shall have to look for the cause of tetany in a nervous local irritation.

Dr. James J. Putnam: I would like to say a word in regard to the cause of tetany suggested by Dr. Carpenter. In the first place, it would seem that this infection, if such it is, could not be of an analogous nature to that found in malaria, where we suppose that some germ having a specific life gives rise to periodical manifestations due to some regular process of growth, because the infection in tetany must be of such various origin, at one time from the intestine, at another from a wound, etc. There is such a variety of kinds of infection noted by Dr. Carpenter that it seems hardly probable that they could act in such a similar way in the different cases unless there was something else behind.

Two or three things have to be considered: First, the great influence of habit. We know that certain spasmodic affections, as chronic torticollis and chronic facial spasm, may be set up in a variety of ways, and then continue, as epilepsy does apparently, because the nervous system gets into a vicious habit. Possibly, also, the destruction of nerve-tissue that results from the denutrition attending the spasm leads to further outbreaks.

There appears to be not sufficient reason to believe that an infective agent accounts for the continuance and periodicity of the attacks of tetany, and the variety of the supposed sources of infection throws doubt, I think, upon the theory.

DR. STEWART: In regard to peripheral irritation, I would state that in the stomach cases, where tetany caused death, the tetany had its origin, not so much in the dilatation of the stomach, but in the washing out. The symptoms came on a few hours after the stomach had been washed out. That would point to the fact that irritation, and not decomposition, was the active cause in that class of cases.

Then we have a large number of cases in which infection cannot enter. In some cases there is no diarrhœa. These cases are not uncommon. In the epidemic cases there can be no infection except through the air.

DR. CARPENTER: I think that Dr. Jacobi's explanation of anæmia as being a cause of nervous irritation is so plain and sensible, that we must all acknowledge it. Dr. Jacobi fails, however, to go back of the anæmia to that which produces it. I know nothing which produces anæmia so surely as septic absorption. The diarrhœas in our army cases were an example of this. The septic absorption in puerperal women produces a remarkable condition of anæmia. The absorption of ptomaines and other septic material will undoubtedly impoverish the blood, producing the anæmia which is the proximate cause of nervous irritation.

Tetany is not a common disease. In thirty-five or thirty-six years' practice I have seen but a few cases. I have seen many cases which could be called tetany if the definition were enlarged. It must be intermittent and be reproduced by compression of the nerve or blood supply of the part, or it is not tetany.

As to the influence of habit. After tetany has been induced there is a condition of nerve instability in which very slight influences will reproduce from habit, if from nothing else, the nervous symptoms which at first were only caused by the absorption of septic poison.

DR. S. WEIR MITCHELL: I should like to say a word in regard to the extreme rarity of tetany, and would ask how many cases of the disease have been seen by members of the Association. Although I have had a considerable experience, I have seen but two cases, one in an adult the other in a child. In Europe the disease is more common than in this country.

DR. WILLIAM PEPPER: I have seen but one case; that was in a child.

DR. A. JACOBI: I believe that it is a mistake to assume that the disease is very frequent in Europe. All writers on the subject affirm that it is very rare. In my own practice I can only recall distinctly five cases, but my impression is that I have seen a few more. I have seen but one in the adult. Occasional epidemics or endemics do not break the rule to a great extent.

THROMBOSIS OF THE CEREBRAL SINUSES AND VEINS.

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THE earlier treatises* on this subject by Tonnelé[1] (1829), Lebert[2] (1855), Gerhardt[3] (1857), von Dusch[4] (1859), Lancereaux[5] (1862), Heubner[6] (1868), and Huguenin[7] (1869), present substantially our present knowledge of it. Since then, the later literature, although unusually copious for so comparatively rare a cerebral lesion, has thrown but little new light upon either its etiology or its diagnosis, but it has at least served to direct attention to the possibility of this accident. In the few remarks I shall make upon it I shall limit myself to certain points connected with the subject, rather than attempt a full exposition of it—a work that has been well done by other writers.

The conditions which underlie thrombosis of the cerebral sinuses and veins are essentially the same as those which determine thrombosis elsewhere in the venous circulation. Our knowledge of these conditions is still very incomplete, and a few words as to its present limits may not be out of place.

1. *As to the influence of a partial or complete arrest of the blood current in the thrombotic process.*

Since the memorable articles of Virchow on thrombosis the importance of this element has been conceded by all writers. The only question in dispute is whether blood-stasis is ever, by itself, the efficient cause, or whether it is merely a condition, more or less indispensable, which favors the operation of the really essential causes.

In the recent controversy as to the parts played in thrombosis by the blood-plates, a new interest in this question has been awakened by the importance attached to this factor by Eberth and Schimmelbusch[8]

* Bibliographical references will be found at the end of the article.

in their experiments for the artificial production of thrombi. They found that with a normal rapidity of the blood current, the blood-plates are carried with the heavier red corpuscles in the axis-stream, while the white cells roll along in the slower peripheral current. In slight retardation more white cells are found in the border zone, but no thrombi are formed; when the current becomes still slower, the blood-plates leave the axis-stream and appear in the peripheral current, where they agglutinate and form thrombotic masses on the site of the vessel lesion. Whether we accept Eberth's conclusion that white thrombi are formed chiefly by agglutination of blood-plates, and differ therefore essentially from ordinary blood coagula—the fibrin and white cells playing merely a subordinate *rôle*—or take the view advocated by Weigert, Welch,[9] and others, that thrombosis and coagulation are substantially the same process; on either theory, slowing of the circulation is unquestionably of great importance. The initial step in the thrombotic process, according to all observations, is apparently an adherence of the formed elements of the blood to the vessel wall, and obviously such adhesion is more likely to occur with a retarded blood current. In situations where an active circulation is usually maintained, as in the heart, the aorta, and even in some aneurisms, extensive roughened surfaces may be present without being covered by a thrombotic deposit. Such slight adhesions of the formed elements of the blood to the vessel wall as may occur from time to time are swept away by the blood current, and in the absence of sepsis are readily disposed of in the general circulation, which seems to tolerate such products if the masses be not too large. Moreover, thrombosis occurs most frequently in vessels with the slower current—in veins rather than in arteries—and in the former selects by preference locations where the tendency to stasis is most marked, viz., the pelvic, the femoral, saphenous and axillary veins, and the cranial sinuses.

On the other hand, there is much evidence that coagulation or thrombosis does not result from mere arrest of the blood current. Brücke ligated the heart of frogs, and found that the contained blood remained fluid, and did not coagulate, although the same blood coagulated spontaneously when removed and exposed to the air in a vessel. Glenard demonstrated that blood can be kept fluid in the veins of a horse for a long time—in fact, until putrefaction occurs. Baumgarten[10]

calls attention to the fact, well known to surgeons since the time of Porta, that in a ligated vessel a thrombus is absent not infrequently, and that when present it does not extend so far as the nearest collateral branch, but stops short of it, thus leaving a part of the stagnating column in a fluid state. Moreover, if a branchless portion of either an artery or vein be ligated with two ligatures, under strict antiseptic precautions, so as to avoid injury to the vessel except at the ligated points, the enclosed blood will often remain fluid for weeks or months —in fact may never coagulate, but be reabsorbed without coagulation. So, also, thrombi are rarely formed in the veins of the lungs and liver during the high degrees of stasis which occur in these situations in connection with marked heart defects and cirrhosis. In many aneurisms and large varicosities, also, where there is necessarily considerable retardation of the blood current, there is often no attempt at a thrombotic process; while the superior longitudinal sinus—the favorite site of marantic thrombosis within the cranial cavity—has been found occluded by enlarged Pacchionian glands or cerebral tumors without any adjacent thrombus formation.

The *rôle* of blood-stasis is clearly a secondary one. In fact, Eberth in a recent article expressly repudiates the idea that a thrombus can be produced solely by slowing of the blood current, and says that he regards this condition merely as a factor favoring the agglutination of blood-plates. The fundamental conditions are to be sought for in vessel lesions and in changes in the composition of the blood.

2. *Vessel Lesions.*—Removal of the blood from the bloodvessels is followed by coagulation. What influence is exerted by the bloodvessels which maintains the contained blood in a fluid state? This question has been much discussed, but even yet has not been settled definitely. Brücke was of the opinion that the blood is kept fluid within the bloodvessels by a vitalizing influence exerted by the vessel wall, while others have supposed that the vessel wall supplies a secretion that in some way counteracts a natural tendency to coagulation. These hypotheses are both defective, because they imply the operation of vital causes, and fail to explain the fluidity of the blood after death.

More recently Freund[11] has advanced the theory that the relation between the vessel wall and its contained blood is mechanical rather than vital, and that the protective influence which has been supposed to be peculiar to the bloodvessels is really shared by all vessels which

present to the blood a non-adhesive surface. He found that when blood is withdrawn from a bloodvessel through a greased canula, is received into a vessel smeared internally with oil or vaseline, and is protected from the air by a layer of liquid fat, it will remain fluid for many days. This observation is in a line with the earlier experiments of Zahn, which seem to show that in all methods for the artificial production of thrombi, such as laceration, crushing, chemical, thermic or electrical injury to the vessel wall, or scraping the endothelium with an instrument introduced through a collateral vessel, the essential condition is the presentation of a roughened surface to the blood current. So also, foreign bodies introduced into a bloodvessel do not become coated with a thrombotic deposit if they are perfectly smooth, while a deposit forms as soon as their surface becomes roughened. Thus a globule of mercury remains free from a coating until the surface has begun to present minute irregularities from oxidation. In phlebitis, too, no thrombus is produced unless the endothelium is involved in the inflammatory process; and, as Virchow has shown, "even abscesses may form, which cause the wall to bulge on both sides like a variolous pustule, without any coagulation ensuing into the cavity of the vessel." Still, even when the intima of a bloodvessel is seriously injured, thrombosis may not ensue unless the blood current be retarded sufficiently to permit an adhesive process. We have already mentioned that extensive atheromatous degeneration or calcareous plates may be present in arteries without the occurrence of thrombosis; while in veins, as has been noted by von Recklinghausen, Eberth, Welch, and others, negative results are not infrequently met with in experiments which freely lacerate the inner wall of the vessel. Such observations by no means disprove the importance of vessel lesions as a factor in thrombosis. They merely show that a certain degree of retardation of the current is necessary to insure adhesive action of the vessel lesion. In marantic thrombosis the vein usually presents no obvious lesion, or only such slight changes in the endothelium as may be accounted for by the irritant action of the thrombus. Still, even in such cases it is quite possible that the initial step in the thrombotic process may be a local alteration of the endothelium that is too slight to be detected by present methods of investigation, but yet sufficient to determine a thrombosis, if the

formed elements of the blood happen to be unusually vulnerable and the local conditions of the circulation be favorable.

3. *Morbid States of the Blood.*—Upon this point, too, our knowledge, it must be confessed, has been "more labored than advanced." Nor is this surprising when we consider that the explanation of ordinary coagulation of extravasated blood, notwithstanding the vast amount of labor that has been expended upon it, especially during the last quarter of a century, still remains an unsolved problem. We know, to be sure, that thrombi are specially apt to form in fermentative conditions of the blood, as well as in cancer, tuberculosis, gout, chlorosis, and some other pathological states of this fluid, but we know nothing as to the essential modifications of the blood that determine the result in these diverse cases. In the days not long past, when fibrin was regarded as an element of the blood, a convenient explanation was at hand in a supposed hyperinosis, or an increased tendency of the fibrin to separate from the blood; but now that the investigations of A. Schmidt and others have made it probable that fibrin is a complex substance formed by the union of the fibrinoplastin of the white corpuscles and the fibrinogen of the plasma under the influence of a ferment, the difficulties of the problem are greatly increased, while still further complications have been added by the recent discovery of the blood-plates, and of their important relation to the thrombotic process.

Nor has much been gained of real value in this direction by experiments upon the lower animals.[12] These experiments, to be sure, have demonstrated that extensive coagulations, sometimes extending from the site of operation as far as the heart, can be produced, although not uniformly, by injecting veins with a great variety of substances that alter the composition of the blood, such as solutions of hæmoglobin, gallic acid, ether, the blood of other animals, defibrinated blood, serum deprived of its corpuscles, the so-called ferment solution of A. Schmidt, lymph-cells obtained from lymphatic glands or from laudable pus, or from the fluid of serous cavities, as well as by mixtures of albumin and lecithin obtained from the testicle and thymus gland of young animals, and which contain no trace of A. Schmidt's ferment. But beyond confirming in a general way the conclusion already reached by clinical observation that dyscrasic states of the blood are frequently the primary cause of human thrombosis, these experiments add but

little to our previous knowledge so long as similar blood-coagulating substances are not demonstrated in the blood of persons suffering from thrombosis, and it is hardly necessary to say that such proof is wholly wanting. Moreover, thrombosis, although occasionally a multiple, is never a generalized affection. The limitation of the process to certain localities, even in cases in which blood-changes seem to be the dominant factor, requires the coöperation of local causes—either a vessel lesion or a local anatomical condition that specially favors blood-stasis.

In thrombosis of the cranial sinuses much importance has been attached to certain peculiarities of the cerebral venous circulation which tend to retard the blood current, and thereby favor the formation of thrombi in this locality. Thus the walls of the sinuses are traversed by bands of connective tissue which not only prevent their collapse, but also form dilatations and projecting partitions; while the more or less triangular form of most of the sinuses increases the frictional resistance of the vessel wall to the circulating blood. Moreover, the cortical veins enter the superior longitudinal sinus at a right or even obtuse angle, in a direction, therefore, more or less opposed to the current; while in the erect posture ascending arteries empty into ascending veins, a mechanism that is peculiar to the brain. In many affections in which the general circulation is slowed by feeble heart action, these conditions must frequently produce in the cranial cavity a state of comparative stasis of the venous blood at certain points, and were mere blood-stasis so important a factor in the thrombotic process as is commonly supposed, cerebral thrombosis ought to be as common as it is actually rare. There are, however, other vascular conditions which not only counteract, to some degree, these impediments to the cerebral circulation, but also tend to relieve the brain from the consequences of a local obstruction to the venous current. The venous channels are valveless, thus permitting a current in both directions; there are free anastomoses between all of the sinuses, many of them having a common centre in the torcular Herophili, while the sinuses of the base are connected with it indirectly. The superior longitudinal sinus and the inferior petrosal sinuses also communicate with the external circulation by means of the emissary veins, and to some extent also through the veins of the diploë. Between the cerebral veins proper there is less inter-communication. Occlusion of these veins usually involves damage to cerebral tissue, but in the sinuses

the blood current may be arrested by compression or by a thrombus without serious symptoms, provided the occlusion be not extensive, or the cerebral veins be not at the same time involved in the morbid process.

To mention only two of the numerous illustrations of this fact in the human subject: Dr. Hershey[13] reports the case of a girl aged eight years, who received a severe blow upon the vertex from the fall of a large stick, which produced a triangular depression of bone into the superior longitudinal sinus at about the middle of the sagittal suture. Several attempts to raise the depressed fragment were followed by such alarming hemorrhages that to save the child's life the fragment was pressed back again into the sinus, and the case was left to nature. The child was nearly exsanguine, but made a rapid recovery, presented afterward no cerebral symptoms, and was in good health at the time of the report, more than a year afterward, although the depression in the skull still remained. Dr. C. E. Isaacs[14] reports a case in which at the autopsy the superior longitudinal sinus was found to be obliterated for three and a half inches by the pressure of an encephaloid tumor, without any cerebral disturbance during life that could be attributed to this cause. No morbid changes were found in the cerebrum, and it was evident that the interruption of circulation through this important sinus had been compensated by the veins of the surface discharging their blood by anastomosing branches into the lateral sinuses, the petrosal sinuses, or the other sinuses at the base of the cranium.

In this connection the recent experiments of Ferrari[15] to ascertain the results of occluding the cerebral sinuses in the dog are so important as to deserve more than a passing mention, and I accordingly give below a brief abstract of them. Ferrari modestly disclaims the intention of applying these results directly to the human subject, but there seems to be no good reason why his general conclusions should not be applicable to man as well as to the dog. The anatomical relations of the sinuses are the same in both, with a few unimportant exceptions. Thus, in the dog the inferior petrosal sinus empties into the occipital sinus instead of into the lateral sinus or the jugular vein, as in man, and the lateral sinus on each side empties into the posterior facial vein, a branch of the external jugular, instead of into the jugular vein as in man. The cavernous sinus also communicates with the facial vein by means of an important vein called the inferior cerebral, which

empties into it below the entrance of the lateral sinus. Injections of the posterior facial vein just below the entrance of the lateral sinus penetrate the latter and a greater or smaller part of the superior longitudinal sinus, while if the injection be made below the entrance of the posterior cerebral vein the fluid passes also into the cavernous sinuses and the sinuses of the base. The cavernous sinuses can be injected also through the ophthalmic vein.

The material used for injection was a mixture of wax and oil, fluid at a temperature slightly above that of the body, but solidifying on cooling to that point.

Experiments were made on eight dogs. Five of them died from a single injection of the posterior facial vein, either immediately or within a period of seven days.

First Dog.—Death in six hours. Complete injection of lateral sinuses, superior longitudinal sinus for about four centimetres, the straight sinus, the left cavernous and left inferior petrosal sinuses. Through the latter the injection had passed into the occipital plexus toward the medulla oblongata.

Second Dog.—Death immediate. Complete injection of both lateral sinuses and the inferior petrosal sinuses.

Third Dog.—Death in an hour. Complete injection of all the sinuses, with extension into the larger cerebral veins.

Fourth Dog.—Injection of posterior facial vein just below entrance of lateral sinus. Operation well borne. Shortly afterward the dog took food and drink. No sensory or motor symptoms. Fever on following day, and death that night. Both lateral sinuses were completely filled, and partly also the superior longitudinal sinus. Other sinuses free, and containing fluid blood. Several wax emboli in the pulmonary artery.

Fifth Dog.—Injection in same situation. After operation the dog ran about actively, but had marked dyspnœa. Pulse weak and irregular. Temperature normal until fifth day, when there was slight fever. Death on seventh day. *Wound septic.* Both lateral sinuses and posterior third of superior longitudinal sinus occluded. Other sinuses free, and containing fluid blood. Large retorsternal abscess in thorax, with marked embolisms in pulmonary artery.

With the last three dogs the experiment was varied by using a smaller injection, and by repeating it with wax of a different color, so that the results of the different injections could be distinguished at the autopsy.

Sixth Dog.—Uncolored wax injected into *left* posterior facial vein. Operation well borne. No cerebral or other symptoms. Wound healed after a few days. The animal remained well for twenty days; then the *right* posterior facial vein was injected with *red* wax. No symptom of any kind until five days later, when it was noticed that the dog refused food and drink. Exami-

nation of the mouth showed numerous painful ulcers on lips, gums, and edges of tongue. Eight days later the ophthalmic vein was injected at the upper border of the orbit with *black* wax. Death almost immediate. The first injection was found to have occluded completely both lateral sinuses, and about four centimetres of the superior longitudinal sinus. The second injection had filled, more or less, all the basal sinuses. The left cavernous sinus had remained partly free. The right cavernous sinus, both inferior petrosal sinuses, and the right ophthalmic vein were completely injected. The third injection had completely filled the left ophthalmic vein and the corresponding cavernous sinus, and had passed by a small anastomotic branch from the ophthalmic vein into the superior longitudinal sinus, where it had occluded all the portion unoccupied by the first injection. Several cerebral veins emptying into this sinus were injected to the extent of from two to three centimetres.

The results in the last two experiments with successive small injections, were similar to those in the one just reported. In the last experiment the first and second injections plugged both lateral sinuses, the torcular Herophili with the adjacent part of the superior longitudinal sinus, both cavernous sinuses, and both inferior petrosal sinuses. The only channels left for the escape of venous blood from the cranial cavity were, therefore, the ophthalmic veins and the vertebral veins, and yet with this extensive occlusion the dog lived for twenty days without noticeable motor or sensory disturbances, and died only from a third injection into the ophthalmic vein.

From these experiments Ferrari concludes that, at least in the dog, occlusion of a sinus of the dura mater produces no serious interference with the cerebral circulation, nor any marked anatomical changes in the adjacent cerebral districts, and that even a large part of the sinus system may be occluded without the cerebral functions being impaired; but that closure of all the channels discharging blood from the cranial cavity destroys life rapidly, usually after the occurrence of epileptic attacks.

If the relation of the sinuses to the cerebral venous circulation be essentially the same in the dog and in the human subject—and there is every reason to suppose that it is—these experiments appear to throw grave doubt on reported cases in which fatal cerebral lesions have been assumed to depend upon a comparatively limited obstruction of the sinuses. It is to be noted, however, that in most of Ferrari's experiments little or no damage was done to the cerebral veins, and that, except at the points occupied by the wax plugs, the venous channels

everywhere contained fluid blood. No thrombi were formed in connection with the plugs, a fact that appears to confirm Freund's observation that blood does not coagulate upon non-adhesive surfaces. In this respect the conditions were radically different from those which obtain in clinical cases of thrombosis of the cranial sinuses in the human subject. Here a thrombus once formed tends to propagate itself *per contiguitatem* in the manner Virchow has so well described. Starting usually in one of the sinuses, it is prolonged into the cerebral veins, and it is to this extension that the fatal lesions, such as hemorrhages, softening, and serous effusions, are commonly due. Occasionally the thrombotic process begins in the cerebral veins, and is either confined to this situation or extends to the sinuses secondarily. Thus Dr. Meigs[16] reports an interesting case in which extensive plugging of the cerebral veins was found at the autopsy without thrombi in the sinuses, and two similar cases are reported by Lidell.[17] In his lectures on the diagnosis of diseases of the brain, Dr. Gowers[18] expresses the opinion that thrombosis limited to the cerebral veins is much more frequent than is commonly supposed. Infantile hemiplegia, which is generally ushered in with convulsions, and is so often followed in after-life by epileptic attacks of a Jacksonian type, he regards as due in most cases to thrombosis of one or more cortical veins. In rapidly fatal cases the superior longitudinal sinus and the veins emptying into it are usually occupied by thrombi, the result of extension from the primary cortical focus during the final period; but in cases which survive the immediate attack and die in later life the lesion found is a shrunken and indurated area in the cortex, but no cavity such as we find when there has been an arterial embolism.

If we except the few instances in which the thrombus is the result of pressure by a tumor, or of direct traumatism, cases of intra-cranial venous thrombosis may be divided into two classes, presenting marked differences in their etiology and symptomatology.

In the first group the cerebral thrombosis is secondary to a thrombotic process starting outside of the intra-cranial circulation and extending to the latter either by the propagation of a phlebitis or by direct prolongation of the thrombus *per contiguitatem.* These external foci are usually produced by caries of the petrous portion of the temporal bone in connection with otitis media, or by caries of any part of the cranium from any cause; by lesions of the scalp, inflammatory or

septic (wounds, sores, eczema), propagated through the emissary veins; by carbuncular and erysipelatous inflammations of the face on such parts of it as communicate with the ophthalmic vein; by purulent inflammations of the deep muscles of the neck, producing a phlebitis that extends into the lateral sinus; and by disease of the ethmoid and sphenoid cells.[19] According to present statistics, this group comprises a majority of the cases, and their pathology is fairly clear.

The second group comprises a somewhat smaller number of cases in which the thrombosis appears to be primary, occurring without an antecedent phlebitis or local inflammation, but generally in connection with a debilitating illness. These are the so-called "marantic thromboses." The term is objectionable, because in some of the cases classified in this "non-inflammatory" group the previous illness has been too slight to be called a wasting disease. All of these cases are characterized by more or less serious blood-changes and by enfeebled heart action, but this combination is too frequent an occurrence to warrant such a generic term for so rare a lesion as cerebral venous thrombosis. Still, this classification is in common use, and may be retained provisionally for its convenience.

Within the cranial cavity marantic thrombosis occurs by preference in the superior longitudinal sinus and the cortical veins which empty into it. It is found most frequently in infants exhausted by diarrhœa with symptoms resembling those of spurious hydrocephalus; also in the last stages of phthisis, after profuse hemorrhages, in senile marasmus, and in chronic cachexia of any kind. These cases have been described fully by numerous writers, and need not detain us; but I desire to call attention to a fact not so well recognized, viz., that "non-inflammatory" venous thrombosis may occur within the cranial cavity, as elsewhere in the body, without preceding conditions that strictly cannot be called "marantic," except in the most elastic signification of this term. I refer to the occurrence of this accident in anæmic adults, particularly chlorotic girls. So many instances of this kind have been reported within the past few years, all of them anæmic women, and most of them in early adult life, that I have made a special group of them, chiefly for the purpose of calling attention to the danger of this accident in connection with chlorosis.

The following case occurred under my own observation during the past year:

Minnie H., aged twenty-five years; Swede; lady's maid. Admitted to St. Luke's Hospital, New York, October 26, 1888. For the past year she has been anæmic, and has suffered from menstrual irregularities and cardiac palpitation, but otherwise her health has been fairly good, and she has been able to attend to her duties as lady's maid. Five days before admission, while at dinner, she was seized suddenly with giddiness and faintness, and was obliged to go to bed. Since then she has had constant severe pains in the head, shooting into the back of the neck and shoulders, with occasional vomiting. On admission patient is markedly chlorotic; the facial expression is peculiarly dull and stupid. She is disinclined to conversation, but answers questions intelligently. Pulse and temperature normal. Urine free from albumin and sugar, and microscopically negative. Her only complaint is of severe frontal headache, and pain in upper dorsal spine. Both pupils react to light and accommodation, but the left is dilated. No paralysis of limbs, face, or tongue. Vomiting continues.

For the next five days the symptoms remained unchanged, except that on the 28th instant, partial deafness was noticed in the left ear, with some photophobia. On the 29th the tongue deviated to the right side; less headache; complaint is made only when questioned. On the 31st blindness in right eye. Nov. 2. Incontinence of urine. Both pupils dilated, left more than right. Nov. 3. Pulse irregular. From this time until her death there was moderate fever, ranging from 99° to 102°. Nov. 4. Less headache, but increasing dulness. Blindness in both eyes. Nov. 5. Ophthalmoscopic examination by Dr. C. S. Bull showed choked disk in both eyes; exudation, hemorrhages into disk and retina, all more marked in left eye. Nov. 8. Paresis of left side of body. Nov. 10. Right pupil dilated, left normal. Nov. 12. Patient uses limbs on both sides equally well. Conjunctivitis of left eye. Much quieter. Nov. 15. Ulceration of left cornea. Nov. 20. Paresis of left side as compared with right. Ptosis and slight divergence of left eye. Weakness of lower facial muscles on right side. Left leg swollen. Death, Nov. 22d, in coma, thirty-two days after first symptoms.

Autopsy by Dr. J. S. Thacher, pathologist to the hospital.

Brain.—In the superior longitudinal sinus is a firm thrombus extending the entire length of the vessel, moderately adherent to the vessel wall, containing pale nodules, of which one is semifluid. In the left lateral sinus is a moderately firm thrombus; in the right lateral sinus an ordinary post-mortem clot. Several of the larger veins of the pia mater over the convexity contain firm white thrombi, and have beside them a very little purulent infiltration. A horizontal section through the middle of the pons shows in the region of the pyramidal tract on the left side a pale patch of the size of a small pea; there is none on the right. Cuts just above and below this show the ordinary appearances of the pyramidal tracts on both sides. The optic thalami and lenticular nuclei show rather more pale mottling than usual.

Lungs.—The left lung contains a few small patches of hemorrhagic infarction. Most of the veins contain clots, which are, for the most part, granular and friable, and are not distinctly adherent to the vessel walls. In the right

lung a little pneumonic consolidation at the back part of the upper and lower lobes. Otherwise like left lung. Other organs normal.

The left leg and thigh were larger than the right, pitting on pressure over the tibia. The upper part of the left femoral vein was examined, and contained a clot which appeared to have been formed post-mortem. The iliac veins were normal.

No diagnosis was made during life. Thrombosis of the cerebral sinuses was not suspected at any time, although the occurrence of swelling of the left lower limb shortly before death certainly pointed to thrombus in that locality, and should have explained to us the real nature of the cerebral symptoms. The clot found in the iliac vein, although apparently of post-mortem origin, was probably formed during life. This complication is specially interesting, as similar cases are reported by others.

Dr. Andrew[20] reports the following case:

Eliza S., aged twenty years, admitted to St. Bartholomew's Hospital March 29, 1865. Had been anæmic for the past year. On admission she complained of headache, which had gradually become more intense, so that on the night of April 2d she was kept awake by it. Next day she vomited several times, and became delirious that night. On the 5th she became insensible and comatose, and died on the following day, eight days after admission.

The *autopsy* showed firm yellow thrombi in the veins of the choroid plexus and velum interpositum, and in the venæ Galeni, extending into the straight sinus and lateral sinuses. Both lateral ventricles were filled with a blood-stained fluid; in the right is a long, thin dark clot laid upon the surface of the corpus striatum and optic thalamus. Septum lucidum entire, but soft. Optic thalami greatly softened, and filled with numerous firm dark clots. Minute hemorrhages in left corpus striatum. Cerebral arteries healthy. No tubercle in any organ. Several branches of the pulmonary artery were obstructed by old clots, some of which were breaking down in their centres.

Dr. W. S. Church[21] reports the case of a young woman, who had been admitted to St. Bartholomew's Hospital for amenorrhœa and anæmia. A few days after admission she complained of intense headache, and appeared dull and drowsy, but answered questions rationally; she then became rambling and somewhat excited in manner, and passed gradually into a state of coma, in which she died. After death the venæ Galeni and the straight and lateral sinuses were found occupied by ante-mortem clots. Both optic thalami were broken down by hemorrhage into their substance, and there was a small mass of extravasated blood in the posterior portion of the left hemisphere.

A third case is reported by Dr. H. W. Tuckwell.[22] The patient, a girl, aged sixteen years, a month before her admission to St. Bartholomew's Hospital, had given up her work on account of weakness, shortness of breath on exertion, and palpitation. For two weeks she had suffered from headache.

On admission, well-marked chlorosis. Expression dull and heavy. Complains of severe pain over the eyes. No paralysis. For the next three days increasing apathy, severe headache, and slowly increasing paralysis of right arm. Coma and death on the third day after admission.

At the *autopsy* firm pale clots were found in the superior longitudinal sinus and lateral sinuses. Extravasation of blood into right middle cerebral fossa. Softening of middle and posterior lobes, also of surface of optic thalami and corpora striata. No disease of cranial bones, and no evidence of inflammation either within or around the sinuses. Cerebral arteries healthy.

Dr. Isambard Owen[23] reports another case occurring in a girl aged sixteen years, who for some time had been anæmic, but otherwise had enjoyed good health until a few days before her admission to St. George's Hospital. On admission she was anæmic to an extreme degree, delirious, and complained of severe pain about the right mastoid process, shooting downward and upward. On the sixth day, severe pain in the temporo-maxillary articulations, almost preventing opening of the mouth. The delirium continued for six days, then drowsiness set in, and death occurred with coma on the thirteenth day. On the third and sixth days the left pupil was larger than the right; on the eleventh the condition was reversed. On other days no inequality.

The *autopsy* showed fibrinous clots in the left common iliac vein and its continuation as far as the knee, and in the right common iliac. Several of the cerebral sinuses were filled with pale clots; that in the superior longitudinal sinus was very large, and was already breaking down into a purulent fluid. The right temporo-sphenoidal lobe was bound by lymph to the dura mater, and the meningeal veins in this region were filled with buff-colored coagula. Brain-substance softened to a considerable depth, as if from purulent infiltration, and spotted with red puncta. No abscess or disease of cranial bones. The case was regarded as one of spontaneous thrombosis occurring simultaneously in the iliac veins and cerebral sinuses; in the latter situation setting up phlebitis in the temporo-sphenoidal region, and, as a late result, cerebritis.

Dr. Samuel Wilkes,[24] in his *Lectures on Diseases of the Nervous System*, reports the case of an anæmic lady, under middle age, who for a week before he saw her had suffered from constant headache, with paroxysms of great severity, but without febrile symptoms. On the following day vomiting occurred, followed the next day by some weakness in right arm and leg, "*but this passed off*." For the next two days continued headache, no fever. Intellect intact. She was seen by several of the most distinguished physicians in London, who agreed that there was no evidence of any organic affection of the brain. On the following day severe vomiting and semi-coma. Death next day, preceded by rigidity of limbs and convulsive twitchings, about twelve days after beginning of illness.

The *autopsy* showed complete occlusion of the superior longitudinal sinus by an adherent thrombus, which was in some places softened in the centre. The lateral sinuses were filled with fibrin as far as the jugular vein. Vessels of the pia mater everywhere filled with coagula, and felt like so many worms

under the finger. No disease of the cranial bones, and no signs of coagulation in any of the other vessels of the body.

Another case of unusual interest, as the patient recovered from the attack, is reported by Dr. Bristowe:[25]

The patient was a governess, nineteen years of age, who had been growing anæmic for the past year. On the day of admission to the hospital she had been attacked with fits, seven of which had occurred in rapid succession. On admission she was insensible, and soon had six more convulsions, epileptiform in character, although the tongue was not bitten, and there was no involuntary discharge of urine. No paralyses. During the next twelve days there was no recurrence of the fits, but she was drowsy, complained much of headache, and vomited frequently. Two days later severe pain about the right ear, with tenderness and swelling in the position of the right internal jugular vein. These symptoms lasted a few days and then subsided. A few days later the same symptoms developed on the left side and ran the same course. Up to this time the diagnosis had remained in doubt, but the occurrence shortly afterward of undoubted phlebitis in the right lower extremity, as indicated by pain and tenderness in the course of Hunter's canal with swelling of the leg below the knee, and a febrile rise of temperature, made it probable that all of these attacks had been produced by a thrombotic process occurring at different parts of the venous system. The patient subsequently made a good recovery.

The same writer also reports a case of thrombosis of the central sinuses and veins in an anæmic girl, who died after an illness of twenty-three days.

At the *autopsy* the venæ Galeni, left lateral sinus, straight sinus, torcular Herophili, and numerous meningeal veins, together with the left internal jugular, were found occluded by firm ante-mortem thrombi.

Still another case is reported by Douglass Powell:[26] The patient, a delicate anæmic girl, aged twenty years, had been in fair health until her present illness, which began with an attack of vomiting a few days before her admission to the hospital. Two days afterward this symptom became more distressing, and was accompanied by severe headache. After three days both of these symptoms were relieved, so that she was able to get out of bed. On the following day she was paler than usual, had a vacant look with partially closed eyes, and her mouth was drawn to one side. She became unconscious, with loss of power in left arm and leg. On admission she was unconscious; the eyes directed downward, the right somewhat inward, and the movements of the eyeballs independent of each other. Pupils somewhat contracted, but equal. Temperature 100°. Death on day of admission.

Autopsy.—Firm ante-mortem thrombi in superior longitudinal sinus, in right lateral sinus, and in the venæ Galeni. Firm particolored clot, dark for the most part, in straight sinus, but lighter where it projected into the tributary vessels. All other sinuses normal. Arteries healthy. Minute multiple hemorrhages in right centrum ovale majus. Right corpus striatum and optic

thalamus were in a state of red softening. Coagulum in right lateral ventricle, due to capillary oozing from choroid plexus. Left centrum ovale contained a few minute hemorrhages.

A similar case is reported by Bollinger.[27]

In a case published by Dr. Crisp,[28] although no mention is made of the attack having been preceded by anæmia, the age and sex of the patient, as well as the character of the symptoms, make it highly probable that the etiology was the same as in the other cases here reported.

The patient was a girl, aged sixteen, who had enjoyed good health, and no cause could be assigned for her illness, which lasted fourteen days. It began with pain in the head, confusion of intellect, and vomiting. At the end of a week the right side was paralyzed, and the mouth was drawn to the left; loss of speech and of power to protrude tongue, also inability to pass water. Pain in head, especially of left temporo-occipital and post-aural regions, extending down the neck, and aggravated to an extreme degree on motion. Frequent screaming and moaning; the left hand was frequently applied to side of head and neck. Pulse never above 80. Normal heat of skin, pupils natural. At the *autopsy* the thoracic and abdominal viscera were apparently normal. Two clots coated with fibrin, about the size of a walnut, in the right auricle. The superior longitudinal sinus was filled with coagulated blood interspersed with portions of fibrin closely adherent to wall of sinus. Thrombosis also of the superior cerebral and cerebellar veins. Arachnoid opaque over its upper and lateral portions on both sides.

Her sister, who generally enjoyed good health, had been attacked eighteen months previously, while lying in bed, with sudden plugging of the brachial artery, followed by acute pain and dry gangrene of hand and fingers, necessitating amputation of the limb. On her return to London, cerebral disturbance occurred, with paralysis of one side, probably from a state of vessels similar to that described in her sister's case.

The diagnosis of thrombosis of the cerebral sinuses and veins is difficult, and can rarely be made with certainty; indeed, the reported cases of correct diagnosis during life can almost be counted on one's fingers. In the great majority of instances the lesion has not been even suspected. This is due, however, partly to neglect of the diagnostic means at our command, as well as to the inherent difficulties of the subject.

More or less extensive thrombosis of the sinuses is found occasionally after death, without marked cerebral symptoms during life. These are probably cases in which the cerebral veins are not involved in the

thrombotic process, the lesion being merely an accidental and harmless complication of the final period of some other affection. When symptoms are present they are usually of the most diverse character, varying with the site and extent of the thrombotic process, as well as with the nature and situation of the secondary lesions in the cerebral tissue, such as congestion, hemorrhages, softening, subarachnoid, and ventricular effusions. In the phlebitic form, moreover, it is generally impossible to distinguish the results of occlusion of the venous channels from the symptoms that belong to the inflammatory and septic changes in the brain.

Much importance has been attached, particularly by German writers, to the diagnostic value of distention of external veins collateral to the intra-cranial circulation. Thus, in thrombosis of the superior longitudinal sinus, epistaxis may occur from engorgement of the nasal veins, or the superficial branches of the temporal vein may be overfilled through the emissary veins, or cyanosis may be observed in parts of the face supplied by the anterior facial veins. The same symptoms may be produced also by bilateral occlusion of the lateral sinuses, since the latter receive the blood of the superior longitudinal sinus. Lateral sinus thrombosis may also give rise to œdema over the mastoid region through a small vein which pierces the mastoid process, or a clot may extend from the lateral sinus into the internal jugular vein, and produce pain and swelling in this region. Unilateral thrombosis of this sinus may also produce unequal distention of the external jugular veins; the internal jugular on the affected side, receiving no blood from the sinus, admits more freely than usual the blood from the external vein, which is consequently less prominent than the corresponding vein on the opposite side. Obstruction of the cavernous sinus, into which the ophthalmic vein empties, may give rise to venous hyperæmia of the fundus oculi, œdema of the eyelids and conjunctiva, exophthalmos, and distention of the frontal vein; and, especially when associated with a periphlebitic process, may excite irritative and paralytic symptoms in the third, fourth, the ophthalmic divisions of the fifth, and the sixth cranial nerves, which before entering the sphenoidal fissure are placed together at this sinus, and are separated from it merely by its lining membrane.

These physical signs have a certain corroborative value, but, unfortunately, they are absent in most cases, as might be expected

from the free intercommunication of the sinuses, and even when present often admit of other interpretations. Epistaxis is too common a symptom in other affections to have much significance in this connection; distended veins running from the arch of the skull to the zygoma are frequently seen on infants in good health, while in adults the presence of hair and the thickness of the scalp usually make it impossible to appreciate this sign. Mastoid œdema occurs in middle-ear inflammations, which, although a common cause of sinus thrombosis, are associated with it only rarely. The ophthalmic symptoms, and those due to irritation or compression of the cranial nerves running in the wall of the cavernous sinus, may be produced also by orbital or intra-cranial tumors, abscesses, and other lesions. Still, these indications of backward pressure from the intra-cranial venous circulation, ambiguous as they are, sometimes throw a strong light on the nature of the attack, and should be looked for in all doubtful cases. Pain and swelling in the region of the internal jugular vein, or the palpation of a thrombus in this vein, is evidence of the highest value in connection with other symptoms, and the same may be said of the occurrence of thrombosis in other external parts of the body.

Lebert (*loc. cit.*) has called attention to a peculiar mobility of symptoms in some of these cases, that contrasts strikingly with the comparatively steady progress of most acute cerebral affections. Thus, when the attack is prolonged over one or more weeks it is often noticed that the cerebral symptoms undergo, from time to time, strange alternations of improvement and aggravation; that the pupils dilate or contract, together or singly, without respect to ordinary rules; while the paretic or paralytic states observed one day disappear on the next, perhaps to reappear at a later period. In my own case, this oscillation of symptoms was very noticeable, and it is mentioned in other reported cases; but no great stress can be laid on this point. More or less marked changes in the symptoms are found in many cerebral affections, particularly in cerebral tumors and in simple basilar meningitis; indeed, the course of the latter affection is strikingly similar in some instances to that of sinus thrombosis. Still, this fluctuation of symptoms is rarely so pronounced, or involves so many areas of the brain, as in sinus thrombosis, and for this reason has a certain value in directing attention to the possibility of this accident. When the symptoms run a more rapid course, especially in the inflammatory variety, this sign is,

for obvious reasons, either absent or so little marked as to have no diagnostic importance.

The marantic form, with which we are more immediately concerned, is met with most frequently in infancy and in adult life—more rarely at intervening ages. In infancy it occurs in connection, as a rule, with an exhausting diarrhœa or other prostrating illness, and then the symptoms resemble those of so-called spurious hydrocephalus. The child is drowsy or comatose; the greater fontanelle may be depressed, and the cranial bones imbricated. These conditions, however, may be due, also, to simple anæmia of the brain. The differentiating symptoms are more or less pronounced motor disturbances, such as convulsions, rigidity of the neck, nystagmus, strabismus, ptosis, and paralysis of the limbs and face. Irritative and paretic symptoms occur, also, in connection with merely anæmic states of the brain, but they are rare in the hydrencephaloid of infants; and when varied forms of paralysis or convulsions are present in such cases, especially if associated with dilatation of external veins, the diagnosis of thrombosis may be made with a reasonable degree of certainty. In the later stages, as Gerhardt (*l. c.*) has pointed out, a change in the greater fontanelle from depression to a marked prominence is sometimes a valuable sign as indicating secondary changes in the brain, such as hemorrhages or hydrocephalus from venous stasis. It must be admitted, however, that the complex of symptoms is rarely so complete as to warrant a positive diagnosis.

But in early childhood, as in adult life, non-inflammatory thrombosis of the sinuses and veins may occur without any marked preceding illness, or even without any assignable cause. The symptoms are convulsive attacks, which may prove rapidly fatal; or, if the child recover, there often remains permanent weakness with frequently recurrent spasms of the affected limbs. According to Gowers, these cases are not infrequent, and "constitute the majority of cases of sudden cerebral disease in childhood." The strict accuracy of this statement seems to me very doubtful.

In adult life, also, we meet with two classes of cases of non-inflammatory thrombosis of the sinuses and veins: one in which the lesion is merely the final act of a prolonged exhausting illness, such as phthisis, typhoid fever, profound malarial cachexia or senile marasmus, while in the other it occurs in persons who are in the enjoyment of

fair health, as in the group of chlorotic cases here reported. In the latter class the onset of symptoms is usually quite sudden, beginning with an attack of giddiness or faintness, or headache and vomiting, or with one or more epileptiform convulsions. Headache is generally a prominent and persistent symptom, but in the protracted cases gradually disappears in the increasing torpor. The patient is dull, listless, disinclined to conversation; the face pale, and the expression vacant, "strange," altogether unlike the apathy of febrile or infectious processes. I refer to this point particularly, because in my own case the combination of pallor and mental obtuseness without febrile symptoms struck me at once as entirely different from the facial aspect of any cerebral affection I had met with before. Active delirium is exceptional; usually in the protracted cases the clouding of the mental functions continues for two, three, or four weeks, or longer, with alternations of improvement and depression, before the final period of coma.

Fever is absent at the outset; if present at all during the attack, it is due to later irritative changes in the brain, or to embolisms of the pulmonary artery, or to complicating thromboses in other parts of the body. In my own patient the temperature was normal for the first thirteen days; from that time on there was slight fever, which was probably excited by the pulmonary lesions found at the autopsy.

Paralytic symptoms of varying extent and degree are usually present during some part of the illness. Aside from the fact that these symptoms often show a mobility that is uncommon in most cerebral affections, there is nothing distinctive in their character. The diagnosis in this class of cases, when possible at all, must be made from the association of anomalous cerebral symptoms with the anæmic state, from evidence in external veins of backward pressure from the intracranial venous circulation, and from the occurrence of thromboses in other parts of the body, particularly the internal jugular or the veins of the upper or lower limbs.

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DISCUSSION.

DR. WILLIAM OSLER: I have here a couple of specimens which illustrate the conditions referred to by Dr. Ball. The smaller specimen is one of extensive thrombosis of the lateral sinuses, and was removed from a man who

died of phlegmonous erysipelas of the left cheek. There were no special symptoms in that case.

In the second specimen, the lesion was more extensive. It was from a case of consumption, and from the gradual onset of the cerebral symptoms I believe that they were due to basilar meningitis. The involvement of the cortical veins is exceptionally well shown.

DR. A. JACOBI: There are some additional or aiding causes in the production of thrombosis which I shall just enumerate, as they are important from a practical therapeutic point of view. One of the conditions which undoubtedly facilitates the occurrence of thrombosis is a disproportion between the white and red blood-corpuscles. In these conditions of anæmia it is true that both the white and red corpuscles are diminished in number, but the first more so. Where, however, there is a relatively greater number of white corpuscles, although it may not amount to leucocythæmia, the slow movement of the white blood-corpuscles along the walls of the bloodvessels will be one of the causes why, in such conditions of anæmia, thrombosis will take place.

Another cause is undoubtedly the absence, or relative absence, of muscular tissue in a number of veins. This is one reason why ergot is absolutely unreliable in any disease of the brain.

A third cause in a number of these conditions is absence of the water of the blood. A thin blood will circulate better than a thick blood. In those diseases in which rapid anæmia occurs, if too little water be allowed, the occurrence of thrombosis will be favored. There are a number of conditions which if an ample supply of water be allowed will not show the disturbances of circulation in which they frequently terminate. Cases of cholera are relieved by the injection of salt water.

Another cause is undoubtedly weakness of the heart, to which we as therapeutists have our attention directed all the time, and whose indications we obey too rarely. When in any exhaustive disease we allow the heart to become feeble, we must expect thrombosis with all its results. It is, therefore, a good therapeutic measure to stimulate and strengthen the heart in almost every—or rather, in every disease that will last long, or that has a tendency to terminate in exhaustion. I believe that we make too little use of heart stimulants in the beginning of disease. We generally wait until so-called heart failure sets in, and then our heaviest ammunition is good for nothing.

These four causes ought to be considered in the discussion of thrombosis. Some of them, I firmly believe, are of great importance in connection with therapeutics.

DR. WILLIAM H. WELCH: Dr. Ball, in his excellent and exhaustive paper, has dwelt upon the structure of thrombi and the conditions of their formation. In addition to the part played by alterations in the vessel wall and by disturbances of the circulation in the causation of thrombi, he has alluded to one factor less known but which probably is of considerable importance. This is the *rôle* played by various forms of blood intoxication in the produc-

tion of thrombi, particularly of marantic thrombi occurring in infectious diseases. The views of Köhler, based on experiments concerning the action of the fibrin ferment injected into the circulating blood, have been confirmed and extended by the later experiments of Hanau, Woolridge, and Silbermann.

I recall a case in which I found, at the post-mortem examination of a woman dying after childbirth, the most extensive thrombosis which has come to my notice. Marantic thrombi were found in the femoral and iliac veins on both sides, in the inferior vena cava, in branches of the pulmonary artery, and in the cerebral sinuses. In such a case as this it seems to me more probable that the thrombosis is referable to some kind of blood intoxication analogous to that caused by fibrin ferment, than that it results from changes in the vascular walls, or stagnation of the blood current, which, as is well known, may be present in extreme degree without thrombosis.

Every pathological anatomist is familiar with the frequency with which so-called marantic thrombi are found in the cerebral sinuses, particularly in the superior longitudinal sinus, without any corresponding symptoms having been observed during life. It is, doubtless, as Dr. Ball has said, when the thrombi extend into the cerebral veins that the functions of the brain are most likely to be disturbed.

THE EFFUSION OF CHYLE AND OF CHYLE-LIKE, MILKY, FATTY, AND OILY FLUIDS INTO THE SEROUS CAVITIES.

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THE object of this paper is to present the subject of effusion of chyle, chyle-like and fatty fluids into the serous cavities. It will be limited to the consideration of the effusion of such fluids into the cavities of the pleuræ, peritoneum, and tunica vaginalis.

Traumatic injuries of the absorbent vessels seem to have been a subject peculiarly attractive to many of the older authors. Ruysch, as early as 1665, drew attention to wounds of the lymphatic vessels, and refers to a certain surgeon "who had, unfortunately, cut a lymphatic vessel in incising a venereal bubo not completely developed, from which flowed daily a great quantity of lymph." Solingen, in 1693, reported two cases of "lymph fistulæ situated at the head of the soleus muscle, one consequent upon a wound, the other produced by contortion of the limb." Muys, in 1695, saw a young man who had been wounded in the left external malleolus, and from the wound "there flowed every day a vast quantity of water." Nuck, in 1733, wrote of wounds of the lymphatic vessels. "Very often," he says, "in venesection performed on the arm, and especially when performed on the foot, the absorbent vessels are injured; by carelessness in regard to these vessels the lancet has proved fatal." Van Swieten, in 1764, recorded the observation that frequently most abundant discharges of lymph followed venesection; and Haller, a few years later (1773), stated that he had known a "flux of lymph of such long continuance, and so difficult to arrest, that he could explain its existence only upon the supposition that a large vessel" had been severed in bloodletting. Mascagni and Assalini, in 1787, cited cases of lymphorrhagia following venesection; the latter mentions the case

"of a boy, eleven years old, who lost five pints of lymph in three days from a slight wound located upon the internal part of the thigh." Soemmerring (1795) and Monro also recorded observations of discharges of lymph following slight wounds; and Schreger (1799) mentions an instance of lymph fistula following bloodletting in the foot. Soemmerring remarks that the healing of wounds on the instep, near the ankles and knees, on the back of the hands, near the bend of the elbows, and near all joints, is impeded by the continual dripping of lymph, and offers the explanation that, as the "absorbents about the joints are protected only by very thin skin and very little fat," the swelling and inflammation which ensue prevent contraction and compression of the incised vessels. In 1817 Nasse recorded several instances of lymph fistulæ caused by traumatic lesions of lymph vessels; in some of the cases he analyzed the fluid discharged and proved it to be lymph.[1] Since then lymph fistulæ from traumatism seem to have attracted but little attention, though quite a large number of cases of lymphorrhœa and lymphorrhagia, occurring in consequence of diseased conditions of some portion of the lymphatic system, have been carefully recorded.

Subsequent to the discovery of the chyliferæ of the dog by Aselli; of the lymphatics in the intestines of man by Gassendi; of the receptaculum and thoracic duct by Pecquet; and of the lymphatic trunks of the extremities by Rudbeck, and about the time when the works of Ruysch, Meckel, Hewson, Mascagni, Cruikshank, and Hunter appeared, there were reported very many cases of chronic ulcers with fistulous openings, from which a fluid was discharged which the observers believed to be lymph. Even as late as 1859, Binet maintained that neglected lesions of lymph vessels would give rise "to ulcers of the most rebellious character," and suggests that ulcers of the lower extremities very frequently owe their origin "to alterations of the lymphatic vessels." Such ulcers may be recognized, says Binet, "by the abundance of the matter excreted, compared to the extent of the ulcer; by the increase of the excreted fluid when gentle pressure is made from the extremity toward the lesion; by the exceptional difficulty in cicatrization, and by the nature of the excretion." During the same period—previous, however, to the publication of

[1] M. Nélaton has three times met with dilatation of lymph vessels at the fold of the elbow, on a level with the cicatrices of bleeding.

the investigations of Mascagni, Cruikshank, Hunter, and Hewson—there were also a number of cases of "milky discharges" recorded. These were evidently cases of copious, and, perhaps, somewhat modified, purulent secretions. The instance of "milky saliva" reported by Antonio Nuck,[1] and the case of "milky discharge from the cutaneous surface of the abdomen" reported by Rommel,[2] are the most authentic of these curious cases. Among these dubious cases may also be enumerated the case of Schurig,[3] of a milky discharge from a wound; the case of fistulous communication with cold abscesses or deep-seated suppurating glands;[4] from the uterus, by Dolæus;[5] from the tunica vaginalis;[6] and from the mucous membrane of the nose, by Richter.[7]

Assalini relates (Binet) having seen, during many months, discharged from the neighborhood of the umbilicus, in two women recently delivered, a fluid which he believed to be of lymphatic nature. Both women succumbed to puerperal accidents. When

[1] "Practicus observed saliva, evidently milky. For a woman, he says, nursing a child, again became pregnant, and therefore weaned the child. The right breast, from neglect, became like a large tumor, and on a certain night subsequently, while suffering much pain, she had an abundant discharge of milk from the mouth, with a corresponding decrease of the swelling in her breast. She swallowed the milk as it came into her mouth (without any inconvenience), which continued for four months."

"But it may be asked, how came the decrease in the breast? In my judgment in no other way than this, that the masses of the blood were laden with chyle, the particles of which could not permeate the lactiferous tubules of the mammæ on account of their collapsed condition, but formed a tumor in those nearest the mammary gland, especially since their arteries were filled and were not capable of removing any more. Indeed, the chylous and milky particles were abundantly distributed through the blood mass, and permeated the glandular structures, especially the salivary, which offered the least resistance. In the meantime, the blood, on account of its freer and quieter motion, propelled the chylous particles remaining in the breast toward the veins, and thus to the heart; hence it followed the breast was emptied." Sialographia, etc., Ductuum Aquosorum Anat. Lugduni Batavorum, 1695, p. 49.

[2] "A woman who was nursing twins began to complain, a few days after the death of one of them, of a sense of dull pain and tension beneath the ribs of the right side of the abdomen and over the umbilicus. This feeling was succeeded by stretching, the stretching by itching, and the itching by an exudation of fluid from the skin, the color, taste, and consistence of which were identical with milk, and which yielded a true butter on agitation." Ephemerides Germaniæ, decur ij., ann. viij.

[3] Parthenolopia, Dresden or Leipsig, 1729.

[4] Med. Essays and Obser., by a Society in Edinburgh, vol. 5, part 1, p. 328. 1747.

[5] Epdem. Germ., decur ij., ann. vj., obs. 76.

[6] Madras Quarterly Journ. Med. Sci., vol 1, p. 180.

[7] Med. and Surg. Obser., Transl. Ed., 1744.

Assalini wrote (1787), the lymphatics were being studied, and it is probable that he accepted conclusions without verification, as did Soemmerring after him, who, perhaps, mistook various collections of pus for metastases of milk. Puzos,[1] whose conception of the pathology of puerperal diseases seems to have been limited to the supposed formation of depots of milk in various parts and tissues, reports several cases in which collections of milk were found in the abdominal cavity. In one instance he found a "gallon of coagulated milk," the patient having died of fever five days after delivery of a dead fœtus.

The view held by Puzos, and by others previous to his time, that milk was formed from the food of pregnant women and passed commingled with the blood throughout the system, being determined, during gestation, to the uterus to nourish the fœtus, and to the breast, after delivery, to nourish the infant, lead very naturally to the conclusion that a superabundant supply or deficient consumption would eventuate in the formation of depots of milk in other localities.

It is probable that the cases of Bossu, Martin, and Milleret (5, 6, and 7) belong to this class of reports; nevertheless the case of "particular dropsy," first observed by Poncy in 1699, was undoubtedly a case of hydrops chylosus. The description of the morbid appearances presents so many conditions so closely analogous to those found in the case reported by Marshall Hughes in 1841 (12) that the apparent vague statements must be attributed to the imperfect knowledge of the reporter, rather than to his fancy.

Frequency.—The reported cases of effusion of chyle and milk-like fluids into the pleural and peritoneal cavities, including the doubtful cases, do not exceed forty-three, and these reports cover a period beginning with Poncy's case in 1699 and terminating with the recent report of the case of chylous cyst of the mesentery by Carson, of St. Louis—one hundred and ninety years. Their infrequency relegates them to the category of pathological curiosities. Nevertheless, twenty-three of the cases of effusion and collection of chyle and chyle-like fluids in the abdominal cavity have been observed during the present century; fifteen of these cases since 1850, and thirteen during the last and present decades. The increasing frequency of occurrence is thus clearly shown. For whilst the more numerous

[1] Mémoires sur le lait ripander, on depots laiteux, new edition, Paris, 1801, p. 141.

reports during these decades may, in some measure, be due to more accurate observation and careful study of morbid anatomy, yet it is not probable that such remarkable cases would have escaped the observation of intelligent physicians at any period since the time of Poncy, Morton, Monro, Scherb, Percival, and Sandifort.

The increasing occurrence of the cases of effusion of milk-like and fatty fluids into serous cavities is more clearly shown by the numerous recent reports of cases of lymphocele by Manson, Lewis, and Sonsino, and in this country by Mastin, Sr. and Jr., and Guitéras. Whether or not this fact is attributable to the more extended habitation and fruitful propagation of the intermediate host of the filaria sanguinis hominis now known to be constantly associated with, if not the cause of lymphuria and lymphocele, is a problem of great interest and graver import.

Effusion into the Pleural Cavities, Chylo-thorax.

There have been, including the doubtful cases, ten reports of cases of injury produced either by disease or accident, either of the thoracic duct or some of its larger affluent branches, in the thorax, sufficient to emit fluid in quantities incompatible with vigorous health, and certainly endangering life, if not causing death. In five of these cases, the chyle poured directly from the duct, in one of which (Bassius) the aperture in the walls of the vessel was not suspected until discovered at the autopsy. In the cases of Hoffman, Guiffart, Bonet, and Quincke the rupture of the duct was the result of external violence. The case of the learned mathematician, reported by Hoffman, was probably a case of empyema, and the case of the Baron de Heinden, reported by Bonet, who was injured by a missile in the battle of Fionensis, is doubtful, though Bartholinus, to whom the details of the case were communicated, expressed the opinion that the thoracic duct was injured. In Curling's case, the lymph concretion which occupied the right pleural cavity was discovered in the body of a patient whose right lower extremity had been amputated at the hip-joint, ten months before his death, for malignant disease of the thigh. The concretion consisted of "softened and degenerated lymph." There was no evidence of malignant disease or "secondary deposits in any of the organs." In the cases of Rokitansky and Ormerod (see 17 and 19, tabulated statement) chyle was found in the pleural and peri-

toneal cavities, in the former the effusion was the result of obstructed heart circulation, and in the latter the result of the interruption of the blood current in the left subclavian vein. In both of the cases reported by Quincke (23 and 24) chylous fluid was found in the pleural and peritoneal cavities, though the post-mortem examination determines the cases as one of "effusion of chyle into the peritoneal cavity," and the other an "effusion of chyle into the right pleural cavity." In both cases the anatomical lesions were clearly made out, in one the duct was lacerated within the thorax, and in the other, chyle retention was caused by inflammatory thickening of both folds of the mesentery. Some of the lacteals were completely, others partially occluded. The chyle vessels were injected exactly to the union of the intestines with the mesentery. The flow of chyle was impeded, engorgement of the vessels ensued, and rupture occurred. But how explain the presence of chyle in the peritoneal cavity in Case 24 and in the pleural cavity in Case 23? In each instance the phenomenon is perhaps partially explicable upon the hypothesis that portions of the effused fluid traversed the lymph vessels of the diaphragm. In the case of Pelletier, the chylo-thorax and chylous ascites were associated with a milky diarrhœa and the vomiting of a milky fluid.

The cases in which fatty and oily fluids, other than chyle, have been found in the pleural cavities have not been included in this collection. A number of such cases have been reported by Hérard, Baccelli, Guéneau de Mussy, Quincke, Debove, and others. Quincke characterizes such fluids as effusions of chyle, Guéneau de Mussy as altered pus, and Debove as chyliform fluids, but specific effusions distinct from serous, purulent, or sero-fibrinous exudations. The clinical histories and morbid appearances associate such cases with tuberculosis and cancer, and determine the inflammatory nature of the exudate. In none of these cases has there been discovered any solution of the continuity of chyle or lymph vessels.

With the exception of the cases of Rokitansky, Ormerod, and one of Quincke, all the cases of effusion of chyle into the pleural cavities belong to a class of casualties which do not admit of any generalization, and are only instructive in suggesting the occurrence of an improbable contingency, which may happen under circumstances very various.

The diagnosis of chylo-thorax cannot be made except by evacuation and examination of the fluid. In Quincke's case of injury by crushing of the chest wall, the effusion was not suspected until discovered by aspiration of the fluid. The prominent symptoms in such cases are dyspnœa, and the accumulation of fluid in one or both cavities. In a single instance chyle was discharged drop by drop through a puncture in the chest wall. The prognosis is unfavorable and the treatment expectant.

EFFUSION OF CHYLE-LIKE OR MILKY FLUID INTO THE CAVITY OF THE TUNICA VAGINALIS TESTIS: GALACTOCELE, CHYLOUS HYDROCELE, CHYLOLECE, LYMPHOCELE, MILKY HYDROCELE, LYMPHOUS HYDROCELE, FILARIAL HYDROCELE.

The case of galactocele reported by Vidal (de Cassis) seems to have been the first observation of this class of effusions. Ruthnum's case of hydrocele, "with contents simulating chylous urine," was published in 1864; and Ferguson's case of "milky fluid from the tunica vaginalis" in 1865. Neither of these cases attracted any special attention, and their reporters seem to have regarded them as curiosities. In Vidal's case the fluid consisted of water, a substance resembling albumen, sugar, chloride of sodium, traces of lime, and numerous globules having the appearance of the globules of butter. In Ruthnum's the fluid looked like milk, and in Ferguson's case it consisted of a colorless fluid in which floated very many globules and a number of minute and large cells not unlike colostrum corpuscles. In each case the fluid coagulated spontaneously. Neither Ruthnum nor Ferguson refers to the case of Vidal, and probably, did not know that Lebert, as early as 1855, had suggested that the case of Vidal was nothing more than the rupture of a "lymphatic varix into the cavity of the tunica vaginalis."

Previous to these reports varices had been frequently observed in the superficial and deep-seated integumentary lymphatic vessels and plexuses, but very rarely, if at all, in the capillaries and plexuses of the serous membranes. Morton, in 1689, and Mascagni, in 1787, observed varices of the pulmonary lymphatics; Caldani, in 1761, described a varix of the lymph vessels of the heart; Wathen, in 1787, and Sandifort, in 1780, recorded cases of dilatation of the lymph vessels of the small intestine. In the latter case the varix resulted

from obstruction of the lacteals, caused by intussusception. Soemmerring observed the dilatation of the lymphatics of the duodenum and of the intestines in herniæ. He also refers to instances in which he had seen the lymphatic vessels of the liver and spleen "filled with a whitish material," and Lebert asserts that he had frequently observed dilated lymphatics on the surfaces of the liver and lungs. Schreger and Tilesius saw a case of dilatation of the lymph vessels of the conjunctivæ.

The fourth case in chronological order was reported by C. H. Mastin (1874), of Mobile, and to him is due the credit of verifying the suggestions of Lebert. After an examination of a specimen of the fluid obtained at the first tapping, I called the attention of Dr. Mastin to this suggestion, and in his second operation in April, 1875, he "opened the sac freely for a distance of two or three inches" and discovered, at the upper portion of the membrane, where it begins to be reflected over the testis, "a granular-looking mass," which having been snipped off was recognized by him to be the "patulous mouths of three or four small vessels," which he believed were "portions of lymph vessels." In 1881, in a similar case, Dr. W. M. Mastin practised the same procedure and discovered a varix similarly located, but when abscissed showed the patulous orifice of only a single vessel, from which lymph exuded. Specimens of fluid from both of these cases were carefully examined by Dr. James Tyson, who described them as comparable to chyle in their chemical and physical characters, and expressed the belief that they found exit into the sac through rupture of a lymph vessel.

These two observations made by our own countrymen, in the city of Mobile, seemed to have established the nature of lymphocele. But, in the meantime, Lewis had discovered the filaria sanguinis hominis, and quite a number of cases of lymphocele, lymphuria, and elephantoid diseases had been reported by Manson, Lewis, Sonsino, and others, in which this parasite was recognized as the probable, if not the constant and positive cause. In this country, since the beginning of 1885, there have been reported thirteen cases in which the filaria were found, two of which were cases of lymphocele; the first in 1886 by Guitéras, in the city of Charleston, and the other in 1888 by Mastin, in the city of Mobile. Manson ascribes elephantoid diseases to embolism of lymphatic glands by the ova of the filaria, stasis, and conse-

quent regurgitation of lymph. If this be true, it is not improbable that the varicose and ruptured lymph vessels of the tunica vaginalis in cases of lymphocele are the result of gland obstruction produced by similar emboli. It has not been shown, however, that filaria are present in every case of lymphocele. It is conceivable that adenitis, gonorrhœal lymphangitis, or other conditions which obliterate the permeability of neighboring and connecting glands might cause stasis of lymph and dilatation and rupture of lymph capillaries and plexuses, with which the serous membranes are so richly supplied. Vidal vaguely hinted that a previous gonorrhœa was the cause in his case; and Mastin, in a review of the previous cases, assumed, in 1883, that chylocele was due to "obstructed gonorrhœal lymphangitis." Since the discovery of the filaria in the third case occurring in Mobile, he has modified his opinion and hints at a classification of causes into filarial and inflammatory obstruction of lymph glands. Sonsino asserts that the theory of mechanical obstruction caused by the adult worm in the lymphatic channels, with all its consequences, as lymphangitis, lymphatic dilatations, rupture, and consequent lymph extravasation or external lymphorrhagia, "is sufficient to explain all the morbid disorders or diseases which have been associated with the worm, and may be originated by it, as lymphuria and lymphocele." The matured opinion of those who have had the best opportunities of studying the relation of the filaria to diseases in general seems to accept the statement of Sir Joseph Fayrer that "it has been shown that disorders of the lymphatic system are most frequently associated with, if not caused by, the filaria." Guitéras asserts that "manifestations of filarial disease may all be included under the head of disturbances of the lymphatic circulation." This view meets with opposition from Rake, who failed to find filaria in cases of elephantiasis and chyluria examined by him in Trinidad.

The chemical and physical properties of the fluid emitted in lymphocele characterize it as a pathological product. Simple dilatation and rupture of a lymph channel, plexus, or space would not necessarily give exit to a fluid so rich in fat and other products.

The recent invasion of portions of the sub-tropical belt of this country by the filaria, and reports of cases of disease with which the parasite has been so uniformly associated, together with the fact that

the mosquito has been proven to be its intermediate host, present considerations of the highest importance to the profession and general public.

The diagnosis of lymphocele depends upon the ordinary symptoms of hydrocele and opacity of the tumor, but the character of the fluid can only be ascertained by observation and chemical and microscopical examination. Vidal noted the absence of translucency. It may be that the general symptomatology of filarial disease coexisting with the collection of fluid in the tunica vaginalis might suffice to determine the presence of parasitic lymphocele, but neither of the cases observed in Mobile seems to have presented such a clinical picture and history. The case cited by Guitéras was associated with commencing elephantiasis scrotus.

Ruthnum cured his case by injections of iodine. Mastin dissected back the varix for a short distance and "tied the bundle *en masse* with a small and very strong silk ligature." Mastin, Jr., practised the same procedure. In both cases the cure was complete.

Chylous and Oily Ascites. [Hydrops Chylosus: Hydrops Adiposus.]

The accompanying tabulated statement, arranged chronologically, presents a brief and condensed summary of the reports of the cases of chylous and oily ascites. A rigid analysis would exclude several from the category of chylous ascites. The cases of Bossu, Martin, Milleret, and Sandifort, which occurred in puerperal women, are so closely allied to the views of Puzos, previously referred to, that they must be accepted *cum grano salis*. In two of the cases there was no extravasation into the peritoneal cavity, one of which was a chylous cyst of the mesentery, and the other a case of chyle retention in the chyle vessels of the mesentery. In several of the cases (13, 14, 15, 21, and 26) the fluid was more oily than chylous and coexisted with tuberculous peritonitis, which would more properly characterize the fluid as a morbid exudation than an effusion of chyle. In three of these five cases the ascites was ascribed to obstructed pulmonary circulation, one of which (13) had suffered for a long time with chronic bronchitis, with "purulent expectoration, containing tuberculous concretions;" another (21) suffered for several years with scrofulous affections and died of pulmonary tuberculosis; and the third (15) died of pulmonary and peritoneal tuberculosis.

CASES OF EFFUSION AND ACCUMULATION OF CHYLE AND CHYLE-LIKE, MILKY, FATTY, AND OILY FLUIDS IN THE ABDOMINAL CAVITY.

No.	Reporter.	Date.	Where published.	Sex.	Age.	Causative conditions.	Treatment.	Result.
1	Poncy, Jr.,[1]	1699	Saviard, Observations in Surgery, p. 247.	F.	Girl	Obstruction of lymphatic glands and vessels.	Medicines and tapping.	Died.
2	R. Morton,[2]	1705	Morton's Phthisiologia.	M.	2 yrs.	Compression of duct near subclavian vein by large tumor behind the trachea arteria, producing rupture of lacteals.	Tapping.	Died.
3	J. G. Scherb,	1729	Haller, Dissertatio Abmorborum, iii. p. 237.	M.	39	Calculus in receptaculum chyli.	Tapping.	Died.
4	Donald Monro[7]	1765	Essay on Dropsy.	F.	Girl	Effort to raise a burthen.	Tapping.	Not stated.
5	Bossu,	1770	Journ. de Méd. Chir. Pharm., xxxiv. p. 283.	F.	...	Metastasis of mammary secretion during first week of puerperium.	Tapping, purgatives, and resolvent applications to abdomen.	Recovery.
6	Martin,	1770	Journ. de Méd. Chir. Pharm., xxxiv. p. 555.	F.	...	Metrorrhagia, miscarriage, unusual exercise.	Tapping.	Recovery.
7	Milleret,	1774	Journ. de Méd. Chir. Pharm., xlii. p. 237.	F.	39	Arrest of secretion of milk from mammary glands and intestinal canal.	Spontaneous discharge at umbilicus and tonics.	Recovery.
8	Ed. Sandifort,	1781	Observ. Anat-patholog., Lugd. Bat., iv. 1-21 3 pl.	F.	...	Following premature birth of twins at seven months. Sandifort refers to another case of lacteal metastasis to abdominal cavity.	Effusion only discovered at autopsy.	Died.
9	Percival,[2]	1788	Essays, Med., Physiol., and Exp., ii. p. 177.	F.	8	Rupture of lacteal vessels.	Tapping.	Recovery.
10	Weaver,	1814	Med. Surg. and Pharm., Repos., ii. p. 377	M.	...	Protracted illness, supposed to be liver disease.	Mercurials and other medicines.	Died.
11	Truman Abell	1833	Bost. Med. and Surg. Journ., vii. p. 13.	F.	...	Abdominal tumor following pregnancy with twins.	Spontaneous rupture at navel and discharge.	Died.
12	Hughes,	1841	Guy's Hospital Reports, v. p. 297.	M.	20	Tumor of agglomerated mesenteric glands. Numerous lacteals were large, tortuous, varicose, and distended with milky or clear fluid.	Not stated.	Died.
13	Van Camp,	1842	Ann. Soc. de Méd. de Anvers, iii. 86.	M.	59	Chronic bronchitis, asthma, tuberculosis.	Not stated.	Died.
14	J. Popham,	1854	Dublin Quart. Journ. Med., xvii. p. 467.	F.	28	Chronic peritonitis, with fat in the effusion; fatty degeneration of liver; free fat in blood; fatty contents of both ovaries combined with hair and bony matter.	Not stated.	Died.
15	M. Lorain,	1859	Compt. Rend. Soc. de Biol., Par. 2, s. v. 162.	F.	8	Symptoms analogous to those of tubercular peritonitis; numerous tubercles in lungs.	Not stated.	Died.
16	T. Stevenson,	1860	Guy's Hospital Reports, 3 s., xvii. p. 231.	...	...	The report refers only to the composition of two specimens of milky fluid obtained from the abdomen.	Not stated.	Not stated.

17	Rokitansky,	1861	Pathological Anatomy, Bd. ii. S. 388.	F.	62	Dilatation of heart, thickening and shortening of mitral valve, occlusion of thoracic duct with soapy material	Not stated.	Died.
18	W. Cayley,	1866	Trans. Path. Soc. of Lond., xvii. p. 163.	M.	19	Fibrinous vegetations attached to intima of subclavian vein; partial obliteration of thoracic duct near its termination; rupture of receptaculum chyli.	Not stated.	Died.
19	Ormerod,	1868	Trans. Path. Soc. of Lond., xix. p. 199.	M.	24	Left subclavian vein and its affluent branches plugged with a light-colored, ragged clot.	Tapping.	Died.
20	Hoppe-Seyler,	1873	Arch. Gesammte Phys., vii. p. 407	...	...	Rupture of chyle vessels from pressure of a tumor.	Not stated.	Not stated.
21	Bergeret,	1873	Journ. d'Anatomie, t. ix. p. 586.	F.	27	Scrofula, pulmonary tubercle, oily ascites.	Not stated.	Died.
22	Wilhelm,	1875	Corresp.-Blat. der Aerztlichen Vereine d. Rhen prov., No. 14, S. 13.	...	2 mos.	Abdominal tumor firmly attached to spinal column in umbilical region. Rupture of thoracic duct.	Tapping, first at two months.	Died.
23	Quincke,	1875	Archiv. f. klin. Med., Bd. xvi. S. 128.	F.	30	Flow of chyle obstructed by inflammatory thickening of folds of mesentery and transformation of interposed adipose into connective tissue.	Tapping.	Died.
24	Quincke,	1875	Ibid., S. 121.	M.	50	Run over by a wagon. Rupture of thoracic duct. Effusion into pleural and peritoneal cavities.	Tapping.	Died.
25	Pelletier,	1875	Journ. de Méd. Chir. Pharm., lxiii. p. 496	F.	...	Chylous fluid vomited: also found in peritoneal and pleural cavities.	Tapping.	Recovery.
26	Ballman,	1876	Centralbl. f. d. Med. Wissensch, xiv.S.275.	F.	39	Peritoneum closely studded with tubercles.	Tapping.	Died.
27	F. Winckel,	1876	Archiv. f. klin. Med. Bd. xvii. S. 303.	F.	39	Puncture of chyle vessels by parasites.	Lived four years; tapping.	Not stated.
28	Winiwarter,	1877	Jahrbuch.d.Kinderheilkunde, vol. xi. Nos. 2 and 3.	F.	Birth	Rupture of congenital chylous cyst; probable occlusion of thoracic duct and dilatation of lacteal vessels.	Careful alimentation and tapping.	Recovery.
29	Kein,	1881-2	Mem. Soc. de Méd. de Strassburg, xix. 2,52,57.	F.	50	Rupture of mesenteric and intestinal lacteals.	Tapping; each time obtained four gallons of milky fluid.	Not stated.
30	F. Nickerson,	1884	Mass. Med. Soc., June, 1884.	M.	55	Chylous cyst; probably continuous hard labor.	Tapping.	Recovery.
31	P. J. Murphy,	1886	Monograph.	F.	19	Violence; long walks and dancing.	Laparotomy.	Recovery.
32	N. B. Carson,	1888	Med. News, lv. p. 52.	M.	39	Chylous cyst of the mesentery.	Laparotomy and removal of cyst.	Recovery.
33	Weichselbaum[3]	.....	Virch. Archiv, lxiv. p. 145.	M.	80	No extravasation, but stasis of chyle in the chyle vessels of the mesentery and hypertrophy of the interposed adipose tissue.	Discovered at autopsy.	Died.

[1] First tapped by Poncy July 2, 1669. Died in 1770, after the twenty-second tapping.
[2] Essay on Dropsy and its Species, by Monro. Third ed., p. 22. London, 1765.
[3] Case of chylangioma cavernosum.

Excluding the puerperal and tuberculous cases, together with the two in which no extravasation was found in the peritoneal cavity (32 and 33), the cases of chylous ascites proper will not exceed twenty-two. In Case 28, Prof. Winiwarter ascribed the intra-abdominal effusion to "congenital occlusion of the thoracic duct, formation of a compound cystic tumor through distention of the lacteals at the root of the mesentery by obstructed chyle, rupture of one of the cysts before or during birth, persistency of this solution of continuity, and increasing effusion of chyle." In the other twenty-one cases the rupture of some chyle-conveying vessels seems to be clearly established.

Etiology.—Age is an unimportant element of causation. The ages of the twenty-two cases vary between birth and sixty-two years. Eleven were females, the oldest sixty-two and the youngest at birth. The ages of the eight males ranged between two and fifty-five years. If the puerperal and tubercular cases be included, sex assumes a more important etiological relation, and the proportion would be two females to one male. Race, climate, occupation, and circumstances of life are without influence. Hereditary and acquired tendency to diseases of the lymphatic system, and especially disease of the walls of the thoracic duct and receptaculum chyli, which are very rare and mainly limited to tuberculous infiltrations and ossific changes, demand mention as primary conditions which may facilitate the rupture of the walls of chyle-conveying vessels; syphilis may also. Primary rupture occurred in but five of the cases. In one (4) the cause was "an effort to raise a burthen;" in two (30 and 31) muscular effort; one vomiting; and one violence inflicted upon the chest. In nine cases the rupture or perforation was demonstrated, and in the others the character of the fluid left no doubt of its escape from a chyle-conveying vessel.

Chylous ascites may be the secondary result of a variety of morbid conditions which directly or remotely obstruct the flow of the chyle through the lacteals, receptaculum, or thoracic duct, impede its exit into the left subclavian vein, or retard the current of blood in the left subclavian vein, right side of the heart, or lesser circulation. Such obstruction may be caused by anatomical defects and anomalies of position and distribution of the chyle vessels, by dilatation or stenosis, and such disease of the coats of these channels as would lessen their expansibility and tensile strength; by disease of the mesentery, hypertrophy, cavernous and fibroid transformation of its adipose tissue; by

indurated, degenerated, and impermeable mesenteric glands, embolism, and deposit of bony, chalky, gelatinous, and soapy material in the channels; compression by inflammatory adhesion or by thoracic, abdominal, and aneurismal tumors. In one case it was ascribed to the presence of the filaria.

Dilated chyliferous lymphatics are quite often observed in the mesentery. The usual cause (Zeigler) is obstruction due to inflammatory or neoplastic growths located in the mesentery or thoracic duct. Sometimes the obstruction is due to lymph thrombosis. The dilated vessels look like straight cylindrical ridges, or convoluted, saccular, or beaded cords; their contents are either white and limpid or pulpy and caseous.

In two cases (3 and 18) the aperture through which the chyle escaped was found in the wall of the receptaculum; in one of which the perforation resulted from ossification of its wall and filling of the cavity with a bony concretion; and in the other, in consequence of stenosis of the thoracic duct, near its outlet. In five cases (1, 2, 9, 12, and 23), and probably in 17 and 19, the rupture took place in the lacteals. In four of these cases, and in the cases of Hoppe-Seyler, Abell, and Wilhelm (11, 20, and 22)—in which no post-mortem examination was made, abdominal tumors were discovered, either by inspection of the cadaver or by palpation during life. In two cases the thoracic duct was compressed by tumors located near its entrance into the left subclavian vein. These tumors were usually glandular, and consisted of hypertrophied and degenerated bronchial or mesenteric glands coexisting, in two instances, with cancerous formations.

In Cases 17 and 19, the chylous effusion into the peritoneal cavity was attributed to interrupted venous blood current in the subclavian and innominate veins; and in Cases 2, 12, and 18 to stenosis of the thoracic duct at or near its entrance into the left subclavian vein. Clinical[1] observations seem to have established the causal relation of interrupted blood current in the large veins near the heart to lymph stasis and effusion of chyle into the peritoneal cavity, and the experiments of Cooper, Morton, Dupuytren, and others demonstrate that complete arrest or interruption of the current of the fluid in the

[1] Busey: The Causal Relation of Obstructed Cardiac Circulation to Lymph Stasis. American Journal of the Medical Sciences, vol. xc. p. 373.

thoracic duct, at or near its terminal extremity, will, if the anastomotic circulation is not speedily and sufficiently established, produce distention, dilatation, and repletion sufficient to cause rupture, which most frequently takes place in the receptaculum or lacteals. Clinical and post-mortem observations are even more conclusive than experimentation, for they connect directly the process of gradual occlusion of the duct by disease with the concurrent development of a diffuse area of lymphangiectasia, which in some cases terminated in rupture and extravasation. In this connection may be cited the cases of Rokitansky, Ormerod, Morton, Hughes, and Cayley enumerated in the tabulated statement, and other cases which I have collated in a contribution to the *American Journal of the Medical Sciences*, vol. xc. p. 373.

The force exerted upon the contents of the thoracic duct by the passing current of blood in the subclavian vein is nothing more than an illustration of the hydraulic principle of Venturi; but the explanation of the relation of cause and effect between cardiac disturbances and lymph stasis and chyle effusion must, in a general way, be sought in the varying conditions of blood pressure. Niemeyer[1] asserts that "obstructive engorgement of the great veins extends to the thoracic duct," and Hertz says an over-distended left subclavian vein will not permit the adequate emptying of the thoracic duct.[2]

The relation of the puerperal conditions to the effusion of chyle are not susceptible of explanation. The theory of metastasis of the secretion of the mammary glands is untenable. In Sandifort's case the uterus and vagina were lined by a pseudo-membrane, which was not detachable; in Martin's case the evacuated fluid resembled whey; in Milleret's case the fluid was at first white, "of the consistency of clear bouillon," afterward gelatinous and offensive, and, finally, soap-like and odorless. Subsequently the patient suffered with lymphatic engorgement of the lower extremities and lumbar region, but finally regained her health. In the case reported by Bossu the secretion of milk was so abundant that applications were made to suppress it, which were entirely successful; then followed the accumulation of milky fluid in the abdomen, which having been evacuated, "the milk returned to the breast," and no reaccumulation followed. Three of these four patients recovered. The occurrence of lymphatic œdema

[1] Text-book of Practical Medicine, vol. i. p. 120.
[2] Ziemssen's Cyclop., vol. v. p. 382.

in Case 7 is the only circumstance in the clinical reports of these cases suggestive of such a diagnosis, but it is insufficient to justify the classification of the case in the category of chylous ascites.

Pelletier's patient (25) was seized with chylous vomiting and diarrhœa, and a chylous fluid was withdrawn by tapping from the pleural and peritoneal cavities. This case was reported in 1875, at a period when a mistake in diagnosis ought not to have been made; nevertheless, the causal relation of the vomiting and diarrhœa to the extravasation of a similar fluid into the serous cavities is not apparent. Sprague reports a "fatal case of vomiting of a chyle-like fluid," but there was no effusion into either of the serous cavities. Chyle may be vomited and discharged *per anum*, and it is not impossible that in rare instances the effort at vomiting might rupture some chyle-conveying vessel.

In five cases the fluid found in the peritoneal cavity was associated with tuberculosis, in four of which it is distinctly stated that the peritoneum was more or less studded with tubercle. The fluid in these cases was very rich in fat, albumen, and chlorides. No perforation or rupture of a chyle-conveying vessel was discovered in any of the cases. They were reported as cases of milky or oily ascites, and their clinical histories picture the ordinary symptomatology of either pulmonary or peritoneal tuberculosis.

Symptomatology and Diagnosis.—The symptomatology of effusion of chyle into the peritoneal cavity is not sufficiently distinctive to differentiate such cases from those of ordinary ascites. Wounds of chyle-conveying channels might be diagnosticated by the location and direction of a stab or puncture, in connection with the escape of chyle into the pleural or peritoneal cavities or externally through the aperture, or its evacuation. As such effusion can only occur through transudation or solution of continuity, its escape externally, or presence in either cavity, must be essential for differential diagnosis. If no fluid escapes externally, then only the symptoms of a fluid accumulation in the cavity are present, the character of which must be ascertained by evacuation and examination.

The quantity of chyle which may escape by transudation is small, and the accumulation is neither rapid nor continuous. When it escapes through an aperture in the walls of some channel the opposite conditions are present. Hence an effusion of chyle might be sus-

pected when a rapid accumulation of fluid in the peritoneal cavity should be associated with sudden loss of appetite, acute emaciation and anæmia, rapid prostration, diminished secretion of urine, and the presence of such conditions as would suggest occlusion, stenosis, or compression of the thoracic duct, or arrest of the exit of the chyle into the subclavian vein. The gradual, partial, and progressive compression of the thoracic duct has been frequently determined by the location of a tumor, associated with evidence of blood impoverishment. In uncomplicated cases due to rupture (Cases 4, 30, 31), "the patient, usually after exertion (Murphy), is suddenly seized with sharp, localized pain, followed by swelling of the abdomen," anuria, anorexia, nausea, and possibly vomiting. In most cases the symptoms are complicated with those of the causative condition, and a diagnosis is only possible by an examination of the evacuated fluid. In no instance has a diagnosis been made previous to observation of the fluid.

Prognosis.—Of the 33 tabulated cases, 19 died, 9 recovered, and in 5 cases the result is not stated. 3 of the puerperal cases recovered, and all the tubercular cases died. Of the 9 recoveries, 7 were females and 2 were males. Of the 22 cases of chylous ascites proper, 12 died, 5 recovered, and in 5 cases the result is not stated. Of the 5 recoveries, 4 were females and 1 a male. In whatever aspect the cases may be considered, the prognosis is unfavorable. The larger number of cases were females, and the larger proportion of recoveries were of the same sex. The female sex, therefore, exhibits greater liability to, and a greater probability of recovery from, chylous ascites than the male. In view, however, of the nature of the causative lesions—perforation or rupture of a chyle-conveying channel—the proportion of recoveries is remarkable.

There is no instance of the preservation of the life of an animal beyond a limited number of days, in which the communication of the lymphatic with the venous system had been completely and permanently obliterated. The wound inflicted by ligation of the thoracic duct could not have caused the death of the animal experimented upon, for in a number of cases it healed by the first intention; neither could death be attributed to the rupture, either of the thoracic duct, lacteals, or receptaculum, nor to the extravasation of chyle or lymph into the pleural or peritoneal cavities, or into the cellular tissue about

the abdominal viscera, for death took place in those cases in which neither of these conditions complicated the ligation of the duct, as it did in those in which one or more of these conditions supervened. When the animals, in cases of experimental ligation of the duct, recovered, the current of chyle and lymph was reëstablished through anastomosis. Monro inflicted a wound in the receptaculum chyli of a pig, from which it apparently recovered, but effusion was arrested by a coagulum. Lower ruptured the thoracic duct of a dog: the animal died after languishing a few days, and two pounds of chyle were found in the right pleural cavity. Bartholini mentions a case in which the thoracic duct was wounded, and the patient lived a long time—"longa fuit tabes." Goodlad refers to the case of a man who was wounded in the duct, who seemed nearly cured, but finally died.

The clinical and post-mortem cases, in which the communication between the venous and lymphatic systems was either partially obstructed or wholly obliterated, are not very numerous; and many of the reports are simple statements of bare facts, wanting in the particulars necessary to demonstrate the effect of obstructed conditions of the duct and lacteals upon the duration of life. Meagre and unsatisfactory as these clinical details are, they, nevertheless, point to two conclusions: 1st, that a free and unobstructed channel of communication between the venous system and chyle-conveying vessels is essential to the proper nutrition of the body and preservation of life; and 2d, that death following the partial or complete obliteration of this communication is the result of inanition. The gradual wasting of the body and progressive debility which so markedly characterize the clinical cases, in which the flow of chyle, either through the duct or anastomosing connections, was insufficient for the maintenance of the normal standard of nutrition, more decisively point to innutrition as the cause of death, than the sudden exhaustion which follows the abrupt arrest of the flow of chyle and lymph toward the blood. In the experimental and traumatic cases there may be the superadded element of violence, but this cannot be a potential influence, for it has been proven that in every instance of experimental obliteration of the communication in which death occurred, no anastomosing connection could be discovered, and in every case in which life was preserved, where proper methods were adopted to eliminate all doubt, such anastomosing connections were found. The causative condition must,

undoubtedly, influence the duration of life, but without the loss of chyle it would, as, for instance, in cases of compression of the channel by a benign tumor, not be very significant.

Clinical reports furnish many cases which illustrate the direct relation, as cause and effect, which subsists between copious losses of lymph and chyle and the marked depression, dulness, and exhaustion which invariably succeed abundant lymphorrhagiæ; and which, likewise, follow artificial occlusion of the thoracic duct, and so distinctly characterize the brief after-life of the animal thus permanently deprived of nutritive material. With but rare exceptions, the cases of copious loss of lymph have been attended with great exhaustion. The latter class may by rest, arrest of the lymphorrhagiæ, and proper alimentation recuperate, to suffer again, and, perhaps, many recurrences, similar in course, duration, and effect, but copious and continuous loss of chyle is inevitably fatal.

Cooper records the observation that young dogs experimented upon by him lived longer than the old, and the lean much longer than the fat. In the clinical cases the average age of the fatal cases was thirty-one years, and in those who recovered it was twenty-four years, but the cases are too few, in which the ages are given, to attach any value, as an element of prognosis, to a difference of seven years.

It is not possible to establish any constant and direct relation between the appetite and the obliteration, perforation, or rupture of the chyle-conveying channels. It lacks uniformity—sometimes diminished, sometimes variable, and again voracious, even in the same patient, but is uniformly associated with progressive emaciation, quite often with fever of the hectic type, and gastro-intestinal disorder, with white and chalky stools. In the case of chylous ascites reported by Poncy, from July 16, 1699, to March 4, 1700, the date of his death, 289 French pints of fluid had been drawn in twenty-two tappings. The evacuated fluid was always chylous, and frequently emitted the odor of articles of diet. In this patient there were progressive emaciation and waste of all the tissues of the body.

Nature of the Effused Fluid.

In most of the cases of effusion into the pleural and peritoneal cavities the fluid was chyle, which had escaped from chyle-conveying channels. In the cases of lymphocele, it was altered lymph,

consequent upon pathological processes affecting primarily the lymph vascular system. In the cases of milk-like, fatty, and oily fluid found in the peritoneal cavity the character of the fluid was the result of coexisting degenerative processes. Quincke, Friedreich, and Klebs have reported cases of adipose or fatty dropsy connected with peritoneal and mesenteric cancer. In some of the cases, especially so in the puerperal, the naked-eye observation of the milky appearance of the fluid was the only circumstance upon which its chylous nature was based. In several of the tubercular cases the analysis established its fatty and oily character, but did not prove it to be chyle. Bergeret's case of oily ascites was associated with suppurating glands; in Hughes's case "cerebriform cancer" was present; and in one of Quincke's cases a cancerous nodule developed in the subcutaneous tissue at the point where the puncture was made to evacuate the fluid. In several of the cases abdominal tumors were found, but their nature was not determined.

The fluid in lymphocele is lymph, in rare instances but slightly altered, containing more water and less corpuscular element, but usually, and especially in the parasitic variety, so changed as to be comparable to chyle. It varies in color from that of ordinary lymph to a canary-yellow, but most frequently is a milky, chylous, opalescent fluid, and always possessing the property of spontaneous coagulation.

In either of the classes of effusion the fluid may contain blood, cholesterine, more or less of the common serous exudation, and some inflammatory product. The chylous effusions are rich in solid matter, albumen, fatty matters, chloride of sodium, and sometimes contain bile, sugar, phosphoric acid, lime, and other undetermined substances, also pus and blood. They are either chyle with moderate admixture of extraneous elements, or chyle-like with more or less chyle dilution with peritoneal effusion and lymph.

The appearance and chemical and microscopical composition of the fluid in chyle and chylous effusions are easily understood, but why the fluid in lymphocele and other lymphorrhagiæ, or found contained, either in a fluid or partially coagulated condition, in lymph-cysts, sacs, or developments, should so uniformly exhibit the appearances and physical and chemical properties of chyle, is not so susceptible of explanation. Numerous observations and analyses have been made of the fluids emitted in cases of lymphorrhœa and lymphorrhagia, and,

with rare exceptions, it has been characterized as an opalescent, lacteous, or chylous fluid, rich in lymph-cells, albumen, and fatty matters, coagulating quickly and spontaneously. In all such cases lymph-stasis was the single condition uniformly present, and the alterations in the constitution of the lymph consisted chiefly in an increased proportion of fibrin, the addition of numerous cell elements, not unlike endothelial cells, white blood-corpuscles, occasionally red blood-corpuscles, lymphoid cells, granular matters, a varying quantity of albumen, and fat.

Various theories have been suggested in explanation of this transformation of lymph. The theory of chyle regurgitation is altogether untenable. Buchanan maintains that the explanation of the white fibro-serous discharges must be sought "in the morbid activity of the multitude of epithelial cells, the function of which had become perverted," by which the fatty matter was eliminated from the blood. Petters offers the theory that the chyle-like fluids are due to fatty degeneration of the endothelium and other formed elements, and in the decomposition of protein substances, which processes are brought about by lymph-stasis. Carter insists that the fluid was chyle flowing in a retrograde current from the lacteals through vessels defective in anatomical construction and directly connected with enlarged lymph glands. Fetzer suggested the absorption by the lymph vessels of the fat tissue of contiguous parts. Roberts held that the structures which produced these discharges "were anatomically related to the lacteal and lymphatic tissues, which, in consequence of hypertrophic development, had acquired "the property and functions of the cells lining the lacteal ducts and glands." Sédillot attributed the milky appearance of the fluid in Vidal's case to the presence of an infinite number of zoösperms, but their presence has been disproven; and Gosselin expressed the belief that it was produced by a combination of the cholesterine and fatty constituents, but cholesterine has been but rarely found in such discharges. In view of the fact that the collections and discharges of such milk-like or chyle-like lymphous fluids are so generally, if not always, associated with thrombosis, narrowing, dilatation, or occlusion of lymph channels, and lymph-stasis, the conclusion seems inevitable that they are pathological products.

Treatment of Chylous Ascites.

In seventeen of the thirty-three tabulated cases tapping was practised, and, in most of the cases, repeated several times. Six of these recovered. In two cases laparotomy was resorted to, with recovery of both patients. One was a case of an intact retention-cyst, and the other was, probably, a ruptured cyst. In the case of congenital cyst recovery took place after several tappings. In one of the cases of recovery, rupture of the umbilicus occurred with spontaneous evacuation of the fluid. The frequent resort to paracentesis was manifestly due to mistaken diagnosis. As a medical resource its value is questionable. The peritoneum is an enormous absorbing surface, which, in cases of moderate effusion, unaccompanied with tension of the abdominal walls, might prove adequate for the reabsorption of the effused chyle and lymph. In cases of large accumulation, with its consecutive disturbances of the circulation and respiration, relief of the distention by the evacuation of fluid would be imperative, but it does not seem wise to empty the cavity completely of a nutritive fluid absorbable through such a vast area of lymphatic apparatus. The fluid should not be all withdrawn, and the operation should be repeated only when made necessary by the distention.

In cases of chyliform ascites, after the fluid has been drawn off it may be useful to inject into the peritoneal cavity weak solutions of medicines believed to promote the cure of chronic inflammatory lesions of serous membranes.

The treatment has mainly been directed to the prolongation of life, and Murphy suggests that in "cases due to rupture of a chyle-duct it should be rest in bed, with light diet of such foods as are digested and absorbed by the stomach, . . . given in small quantities at short intervals, and a restricted quantity of water and other liquids, the object being to prevent distention of the ruptured ends of the lacteals and the formation of a coagulum." This, together with a general tonic plan of treatment, has, apparently, proven successful in at least two cases, and has certainly prolonged life in other cases.

The causative condition may, in some cases, be amenable to medicinal treatment; but in most cases, especially in those in which the effusion is attributable to the pressure of a benign tumor, some surgical

procedure might offer a prospect of cure. In case of chylous cyst (32), removal is certainly justifiable.

In filarial cases the treatment applicable to such would be admissible. Guitéras asserts that patients "with filaria can hope for no permanent relief, except in the death of the adult worm. This happens occasionally, but cannot be brought about by treatment." Sonsino thinks some good may be accomplished in filarial diseases by the employment of astringents, such as gallic acid and the tincture of the chloride of iron, together with rest, tonics, and proper alimentation, but that alimentation must not be pushed to the point of repletion and distention of the lymphatic vessels.

Lancereaux asserts that filiarosis, a term which he applies to the parasitic forms of lymphatic diseases, is curable, though it may last for some time. He has found mercurial inunction in the region of the affected glands of service, in connection with hydropathy, and suggests the injection of parasiticides into the affected lymphatic ganglia to destroy the female adult worm. He, as do others, asserts that removal from the source of infection may result in spontaneous cure.

NOTE.—I append the following abstracts of cases, which have been collated since the paper was in print. They are not referred to either in table or context of the paper. They are, however, of special interest, because more carefully studied and reported than many of the tabulated cases; and, furthermore, because they show conclusively that fatty and oily fluids associated with cancerous and tubercular diseases of the peritoneum and abdominal viscera, or even with chronic idiopathic peritonitis, are not necessarily and exclusively products of such morbid conditions. They supply additional proof, also, of the incorrectness of the theory of Guéneau de Mussy, which Letulle has formulated into two distinct propositions: First, that all cases of chyliform ascites are simply cases of chronic tuberculous, cancerous, or neomembranous peritonitis; and, secondly, that granulo-fatty retrogression of inflammatory products is sufficient to hold all the emulsified fat in suspension in the peritoneal cavity. It may or may not be true, as maintained by Debove, that emulsified fat can be formed in the serous cavities, but the fact is demonstrated by the autopsies in the cases of Whitla and Straus, that while a portion of the fluid may have been an inflammatory product—how much can only be ascertained by physical, chemical, and microscopical examination—yet a

portion was chyle. In each of the cases the aperture or perforation of a chyle-conveying channel was distinctly demonstrated.

Chylous Ascites.

Case XXXIV.—Reported by H. Smidt, with permission of Guttmann, *Zeitschrift klin. Med.*, 1880–81, p. 199. Male, aged eleven years. When one year old had variola, followed by pneumonia, which recurred later. Had had measles and "catarrh of the lungs and intestines." When eight years old abdomen began to swell, but otherwise well. Remained six months in hospital; discharged apparently well. Abdomen remained normal for a year, then ascites more or less till his eleventh year. Aspirated in Langenbeck's clinic. A large quantity of "milky fluid" withdrawn; ascites rapidly returned. At the present time is able to stand and walk; mind clear, skin clear, no anasarca, no eruption, no marked wasting. Respiration rapid, chiefly costal; pulse 120, mucous membrane pale, diminution of red corpuscles, moderate relative increase of white. Greatest measurement of abdominal circumference 87 cm., veins of wall prominent. Appetite good, urine 6.700 c. cm. daily; sp. gr. 1.014–1.019, acid, no albumin, clear and yellow; 6.350 c. cm. of milk-white fluid withdrawn by aspiration; sp. gr. 1.022, reaction neutral; much albumin and fat. Eleven days after aspiration, fever which disappeared soon, pain in muscles of neck and headache, delirium at night. Pain continued till death, which was sudden and preceded by a loud cry twenty-nine days after last aspiration.

Autopsy.—Cerebral abscess and meningitis; mild peritonitis, mesenteric glands normal; chyle vessels not injected, mucous membrane of stomach and villi of duodenum and jejunum hypertrophied. Thoracic duct empty and normal.

Fluid, analysis by Guttmann, contained 5.25 per cent. of fat, and 3.50 per cent. serum-albumin, no peptone, no sugar-forming ferment. Stern found in a specimen of the fluid from this patient a larger per cent. of albumin, but less of fat, and traces of sugar and peptone.

This case is one of peculiar interest, because the chyliform effusion was the product of a chronic idiopathic peritonitis, and in that respect probably unique.

Case XXXV.—Reported by Whitla, *British Medical Journal*, vol. i., 1885, p. 1089. Male, aged thirteen years. Family history phthisical; personal history of pulmonary affections. In three months 117½ pints of chylous fluid withdrawn, albuminous, slightly alkaline, with faintly saline taste, and pleasant smell, and possessing corpuscles like white blood-corpuscles, few red blood-disks, few large exudation corpuscles, numerous small molecular bodies, resembling the molecular base of chyle, fat, albumin, sugar, and other organic matter. The peritoneum, mesentery, and pleura were studded with miliary tubercles; liver and lungs everywhere infiltrated with millet-seed granulations.

The thickened peritoneum and mesentery, together with enlarged and infiltrated mesenteric glands, formed a tumor lying across the spine about level with the umbilicus. Thoracic duct dilated in lower third, with perforation at its lower end, and occluded at its middle and upper third with tubercle nodules. Receptaculum dilated and ruptured.

CASE XXXVI.—Reported by M. I. Straus, *Archiv. de Physiology, Norm. et Pathology*, xvii. p. 367, 1886. Male, aged sixty-one years. Habitual good health. Four months before admission lost appetite, with progressive weakness and loss of strength. Distress after eating, abdomen enlarged, never vomited; during past month abdominal enlargement rapidly increased. On admission emaciation extreme, considerable ascites with fluctuation, marked enlargement of superficial abdominal veins; slight œdema of ankles disappearing with rest; poor appetite; eats everything and digests the little eaten; no fever; urine scanty, clear, without sugar or albumin; habitual constipation; nothing marked about heart or lungs. Tapped on account of distress; six litres of liquid like weak coffee with milk or chyle, opalescent, yellowish-white. After tapping noticed about umbilicus and left hypochondrium hard, knotty tumors, slightly tender. In left groin tumors of size of a nut, hard and indolent. Effusion returned in two days, and again tapped. Afterward absolute diet of milk with butter. Effusion rapidly returned. Died after third tapping. Fluid consisted of solid and mineral residue, fat, and albuminoids. Fat greatly increased after the milk and butter diet.

Autopsy.—Cancer of peritoneum. On anterior surface of the mesentery were small perforations of chyle-vessels, exuding a whitish liquid like milk or chyle. Subserous effusion of chyle in small intestine from duodenum to ileo-cæcal valve, varying in size, not on stomach or large intestine. Thoracic duct normal. Primary alveolar cancer, starting from pylorus.

CASE XXXVII.—Reported by Letulle, *Rev. de Méd.*, p. 960, 1885. Male infant, three months old. Chronic disease of the abdomen for two months. Ascites and œdema of lower half of body. Recent reducible umbilical hernia. Subcutaneous veins enlarged. Liver greatly enlarged. Orthopnœa; face cyanosed; heart irregular, pulse 136 to 140; no fever; no appetite; urine high colored, no albumin or sugar; constipation, no jaundice. Dyspnœa increased during night. Letulle ascribed illness to congenital cardiopathy and chronic peritonitis, others to cough and syphilis. Tapped and given digitalis. First tapping fluid clear and yellow, second thick and milky, third thicker and more milky, fourth chyliform. Child improved.

CASE XXXVIII.—Reported by Chomel, *Mem. de l'Académie Royale des Sciences*, Paris, 1728. Female, aged twenty-four years. In childbed; on third day abdomen swollen, inflamed and painful; during night awoke with rupture at umbilicus, from which flowed five pints of a milky, grayish, serous fluid. Sac extended in hypogastrium to the pubis and groin, and was ascribed to rupture of lymphatics. Cured in two months by a counter-opening.

CASE XXXIX.—Reported by Letulle, *Rev. de Méd.*, iv., 1884, p. 723. Male, aged eight years. Rheumatism involving heart two years before.

Second attack also affecting heart. Œdema of legs, rapidly involving thighs; ascites; liver and spleen enlarged; constant vomiting. Tapped. Fluid yellowish, containing granules, leucocytes, and fat globules. Died in fifteen days.

CASE XL.—Reported by Veil, *Paris Thesis*, No. 21, 1882. Female, twenty-five years old. At ten years had an eruptive fever. Previous health good. Gradual enlargement of abdomen; diarrhœa and œdema of legs. Died after second tapping. Fluid rich in fat globules, with few leucocytes. Syphilitic gummata of liver.

CASES XLI., XLII., and XLIII.—M. E. Gaucher, cited by Veil, reports three cases of chylous ascites. One was a case of cirrhosis of the liver in a man, aged forty-seven years, who was a hard drinker. The fluid in three tappings was milky and contained fat, but in the fourth tapping was like the fluid in ordinary ascites. The second was a male, thirty-nine years old, a common drunkard, with cirrhosis of the liver. The fluid from the first and second tappings did not differ from ordinary ascitic fluid, but was milky in the third. The third case was a child eleven years old, with sarcoma of omentum and mesentery, and enlarged and degenerated mesenteric glands.

ADIPOSE ASCITES.

CASE XLIV.—Reported by Quincke, *Archiv klin. med.*, xvi., 1875. Female. aged thirty-three years. Multipara, soon after delivery seized with swelling of abdomen, short breath, and loss of appetite. Tapped because of dyspnœa. Fluid pale yellow, containing fatty cells and fat globules. Tapped second time and died in collapse. Primary cancer of peritoneum.

CASE XLV.—Reported by Quincke, *loc. cit.* Girl, aged ten years. After scarlatina, had diarrhœa, abdominal pain, and ascites. Fluid contained flakes of albumin and fat.

CASE XLVI.—Cited by Quincke, *loc. cit.*, from Friedreich. Girl, aged twelve years. Acute swelling of cervical glands, followed in fourteen days by ascites. Four tappings in two months. Fluid milky with fat and fatty cells. Miliary tuberculosis. Death.

DISCUSSION.

DR. WILLIAM OSLER: My experience with these conditions is extremely limited. In ordinary post-mortem work we not unfrequently see varices of the chyle vessels of the mesentery or of the intestine. Sometimes also we see extravasations which may occasionally form large chylous cysts. I do not think that such conditions are very uncommon. Still more rarely we see thrombosis of the chyle vessels, much more commonly in the lacteals than in the thoracic duct.

I have but once seen chylous exudation; the specimens were sent to me ten

or fifteen years ago. I do not remember whether from the peritoneum or from the pleura.

There is a theoretical explanation of some of these cases. It is a well-recognized fact, although not so widely known as it should be, that persons fed upon an absolute milk diet may have a condition of lipæmia more or less permanent. It is possible that in such conditions as diabetes, where a condition of fatty liquor sanguinis exists, the exudation might contain the molecular base of the chyle in sufficient quantity to cause turbidity or even opacity.

With reference to chyluria, I can speak positively of a non-parasitic form of the affection. Some years ago, I studied the case of a French Canadian woman who had never been out of the Province of Quebec, and who for many years had this condition of chyluria. It was impossible to distinguish the urine from milk. The blood was repeatedly examined between the hours of 10 P.M. and 4 A.M., with negative results. I was not without experience in the examination of the blood, as I had already seen two cases of parasitic chyluria, and I can speak positively in regard to the absence of filaria. At the post-mortem examination there was absolutely nothing discovered. There was nothing to indicate the source of the fluid. There was no such condition as that figured by Mackenzie in his well-known case.

The condition of lymph scrotum may also be non-parasitic; certainly we meet the condition without the presence of the filaria in the blood. It is quite possible that the female worm may have periods of sterility during which embryos are not passed into the blood, and yet the condition may persist. Two years ago I had an opportunity of thoroughly studying the fluid and the blood from such a case, but in neither was there any evidence of a parasite. I lay a great deal of stress upon the first case to which I referred, as it is generally stated that the condition is always parasitic. I feel certain that there are cases of non-parasitic chyluria, although they are rare.

DR. WILLIAM H. WELCH: By way of illustrating Dr. Busey's paper, I have brought with me and here present a specimen of the fluid from a case of chylous ascites. The specimen was recently sent for my examination by Dr. McNamara, of New York, who has at different times withdrawn by tapping several quarts of similar fluid, exactly like milk in its optical properties, from the abdominal cavity. The patient is a boy, whose clinical history does not render clear the cause of the affection.

Save here and there a stray leucocyte or red blood-corpuscle, the only morphological elements to be seen microscopically in the fluid are extremely minute granules, so minute that they cannot be recognized as fatty globules. This granular matter can be dissolved in ether, and on evaporating the ether drops of oil remain. No filaria are present.

Those who will look through the literature relating to chylous effusions, will perhaps be surprised to find that the pathology of the affection is involved in considerable doubt and differences of opinion. Quincke advanced the subject by distinguishing clearly between chylous and fatty hydrops, a distinction

of much importance, although often lost sight of. The microscope enables us to distinguish between these two affections, as in fatty hydrops there are larger oil globules, and also fatty granular corpuscles and lymphoid and other cells in various stages of fatty degeneration.

There are many writers who entirely reject the view that the chyle-like effusions in the peritoneal and the pleural cavities are due to the escape of chyle from the chyle vessels. They argue that in such cases post-mortem examination has not furnished satisfactory demonstration of the existence before death of rupture of chyle-containing vessels, that the chemical constitution of the fluid differs in some respects from that of chyle, notably in the absence of sugar, and that similar effusions are to be found in parts of the body where no chyle-containing vessels exist.

Notwithstanding these objections, it seems to me to have been demonstrated that the chyle-like effusions in the serous cavities of the abdomen and chest are in reality the result of the escape of chyle by rupture of the lacteal vessels or of the thoracic duct. In many instances cancerous and tuberculous masses obstructing large numbers of the lacteals at the root of the mesentery have been found, with plain evidences of damming back of chyle and rupture of lacteal vessels. I do not think that the mere occlusion of the thoracic duct, still less obstruction to the venous flow in the subclavian veins, is followed by serious interference with the flow of lymph or chyle. I have found the thoracic duct completely occluded by a tuberculous thrombus, in a case of acute miliary tuberculosis, without any such effect. Straus has shown in his interesting paper that the ingestion of substances like butter, which are absorbed by the lacteals, causes a corresponding change in the composition of the chylous effusion. In Whitla's case the guarantee that the perforation found in the thoracic duct occurred during life, is furnished by the character of the hole and by the dissection of the skilful anatomist, Redfern.

SUBSTITUTES FOR OPIUM IN CHRONIC DISEASES.

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OPIUM is the most conspicuous article in the Pharmacopœia. Its extraordinary efficacy in relieving pain, the versatility of its powers, and its reliability in emergencies, give it a preëminent standing. It is generally recognized by the medical profession as the most indispensable of drugs. But, while surpassing other remedies in its beneficent effects, it is alike remarkable in its power for harm. Hence, its medical use requires a degree of caution not less than that with which the surgeon handles the scalpel. When to administer and when to withhold it, constitute one of the gravest of medical problems. There are times when the dangers and disadvantages of this most brilliant of drugs seem wholly out of proportion to its benefits. A growing dissatisfaction with opium is the motive of the present paper, which is designed as an argument in favor of restricting the use of opiates to a greater degree than has hitherto been the prévailing custom.

The disadvantages of opium are these:

1st. In an overdose it is an active poison.

2d. In ordinary doses its benefits are largely offset by various functional derangements.

3d. Its use involves the danger of the opium-habit.

1. *Opium in an overdose is an active poison.* This, which at first sight appears the greatest of its disadvantages, is, in fact, the least; for the very imminence of the danger compels caution, and the dose can be so regulated as to reduce this danger to insignificant proportions. Hence, in careful hands, fatal accidents from opium are almost unknown.

2. *In ordinary doses the benefits of opium are largely offset by various functional derangements.* This constitutes an objection to

opium far greater than the preceding; for the secondary effects of this drug are almost always prejudicial. These effects include digestive disorders, constipation, impairment of the hepatic function, headache, depression, and various nervous disturbances. Oftentimes these effects tend to keep up the very condition of the system which necessitated its use—for instance, in gout, rheumatism, and lithæmic neuralgia.

3. *The use of opium involves the danger of the opium-habit.* That this habit is widespread there can be no doubt; for there are probably few physicians who are not cognizant of some such cases, and there are certainly many others which never come definitely to our knowledge. It is obviously impossible to get accurate statistics concerning a habit which is, for the most part, jealously concealed. The public prints are somewhat given to extravagant statements in this direction; but the estimate which places the number of opium-takers in the United States, exclusive of the smokers, at 150,000[1] does not appear exaggerated. In proportion to the number of alcohol inebriates, this number appears insignificant; and yet it represents a vast amount of misery, for the slaves of opium are, in some respects, more wretched than those of alcohol. The worst feature of the opium-habit is, that its paralyzing influence upon the will renders it almost incurable. To renounce the habit is next to impossible without the aids which are offered by an institution. Even then relapses are the rule. A lady, whose case has come under my observation, has twice been "cured," as was supposed, in two different institutions, remaining three months in each. The first time she remained "cured" for just two weeks, and the second time she went direct from the institution to a drug-store to purchase morphia. The efforts of the excellent men who are lavishing their skill upon these unfortunate cases deserve to be better rewarded. That permanent cures are occasionally effected I know from personal observation, and yet the rarity of such cases is evidenced by the words of Dr. B. W. Richardson,[2] who says, as the result of a large experience: "I have never yet known an instance in which I could be quite sure that the fully confirmed habit has been absolutely or permanently abandoned. I may have heard of such, I have seen none."

[1] I. A. Loveland, M.D.: Quarterly Review of Narcotic Inebriety, Oct. 1888.
[2] Practical Notes on the Morphine-habit. Asclepiad, 1888, vol. v., No. 20.

It has been charged[1] that the medical profession is largely responsible for the prevalence of the opium-habit. That some cases do result from opiate prescriptions cannot be denied; but it is my belief that, in the practice of educated and respectable medical men, such occurrences are very rare. Physicians are incessantly warning their patients against the dangers of opium, and, as a rule, administer this drug with the utmost caution. The prime cause of the opium-habit is undoubtedly to be found in the unrestricted sale of opiates, and in the multitude of proprietary nostrums containing opium. Among the latter are included nearly all of the alleged "cures for the opium habit."[2] It is true that the drug is usually taken in the first instance for the relief of pain; but this is constantly done without a physician's advice. When ordered by a medical man the dose is so regulated as to counteract the pain, and no more; but when taken ignorantly the dose is likely to be so large as not only to relieve the pain, but also to allow an excess which may cause intoxication. In those cases of inebriety attributable to physicians' prescriptions, the fault usually consists in the unlimited renewal of the prescriptions—a great abuse which needs legal restriction.[3] If physicians, instead of writing prescriptions for opiates, would dispense all such remedies themselves, much good would result.

No doubt opiates are sometimes administered unnecessarily, for it is in the nature of things that this should occur. The pleadings of an impatient sufferer must at times influence a sympathetic physician to give opiates against his better judgment. Our people are, to a great

[1] J. B. Mattison, M.D.: The Responsibility of the Profession in the Production of Opium Inebriety. Medical and Surgical Reporter, Philadelphia, Feb. 9, 1878.

Ibid.: The Genesis of Opium Addiction. Detroit Lancet, 1884, vol. vii. p. 303.

I. A. Loveland, M.D.: The Morphine-habit. Quarterly Review of Narcotic Inebriety, July, 1888.

Ibid.: The Abuse of Opium. Same Journal, June, 1889.

How the Opium-habit is Acquired. Ed. Journal of Amer. Med. Association, Sept. 22, 1888, referring to Virgil D. Eaton, in Popular Science Monthly.

F. E. Oliver, M.D.: The Use and Abuse of Opium. Third Annual Report Massachusetts State Board of Health, 1872.

[2] B. F. Davenport, M.D.: Seventh Annual Report of State Board of Health, Lunacy, and Charity of Massachusetts, 1886, p. 190.

[3] Loveland: The Refilling of Prescriptions. Quarterly Review of Narcotic Inebriety, April, 1889.

J. C. Wilson, M.D.: The Causes and Prevention of the Opium-habit and Kindred Affections. Boston Medical and Surgical Journal, Nov. 22, 1888.

extent, both self-indulgent and neurotic. They refuse to bear pain, and are apt to prefer the doctor who gives the quickest relief. It is pleasanter to give a hypodermic injection than to refuse it to a suffering and unreasonable patient. These influences cannot be ignored, for even doctors are human at times.

In acute cases the use of opium is comparatively safe; for in such the number of doses is usually not large, and the patient is wholly under the physician's control. In the last stage of incurable diseases the objections to its use are still less. But in chronic cases opium needs to be used with the greatest caution, for here the unfavorable effects upon the system are the most marked, and the formation of the opium-habit in such cases is particularly to be feared. The reason for the latter is that the necessity is of longer continuance, and, the patient being under less constant supervision, is liable to continue taking the opiate without the physician's knowledge. It is necessary, therefore, in such cases to abstain from the use of opiates whenever possible. This necessity is generally recognized by the profession, but opinions must naturally differ as to what circumstances imperatively demand their use.

The usual reason for giving opium is the belief that no other remedy is capable of accomplishing the result desired. Opium has hitherto been almost the only reliable analgesic; but recent discoveries in therapeutics have done much to lessen our dependence upon it, since they have placed within our reach several safer remedies which are capable of being used as substitutes. The avidity with which the new analgesics are seized upon by the medical profession and their powers tested is an indication of the deep-seated antipathy to opium, and the desire to be emancipated from its rule.

The family physician has ample opportunity to observe the necessity for seeking out such substitutes. Feeling the responsibility, not only for the present but also for the permanent well-being of his patients, and deeply interested in the future of the rising generation, he shrinks from giving present relief at the cost of ultimate harm. He must almost inevitably hold the secrets of opium-takers—few or many—and, seeing the cloud which overshadows them and their offspring, must grow more and more determined that the future of other families shall not, if in his power to prevent it, become so darkened.

The strength of the revolt against opium is shown in these words

of Dujardin-Beaumetz:[1] "The older I grow, the more chary I become in the use of morphine, for, despite the marvellous powers of this alkaloid, which is by far the most active of analgesics, its dangers and disadvantages are such that I reserve its employment for exceptional cases only."

We will now pass to a brief consideration of some of the remedies which can properly be regarded as substitutes for opium in chronic diseases.

For the Relief of Pain.

The discovery of the analgesic powers of the antipyretics is a notable event in therapeutics. Making due allowance for the enthusiasm which their novelty has excited, the fact is definitely established that these remedies are valuable additions to the Pharmacopœia. It was not to be expected that they should be free from drawbacks, and naturally each has its defects and limitations. The two oldest of the group, antipyrin and acetanilid, have already been sufficiently tested to have their sphere of action pretty clearly circumscribed. Phenacetine is growing in favor; while exalgine has already made an excellent impression. These remedies have well-grounded claims to be regarded as rivals to opium. Their power for relieving pain is extraordinary, in many cases equal and occasionally superior to opium. They appear, as a rule, however, less prompt and less certain, especially when pain is very violent. As an offset to this inferiority, they have the advantage over opium of being less dangerous, causing less derangement of the system and not leading to any enslaving habit. Their effectiveness in migraine where opium is given, if at all, only as a last resort, and in the milder forms of neuralgia, is very striking. But the essential question which now concerns us is, whether they can be depended upon in severe forms of pain in which opium would otherwise be a necessity. That they do fulfil this indication much evidence is already on record.

Antipyrine — the oldest of this group, besides its antipyretic, antispasmodic, antidiabetic, and other powers, has proved itself a most valuable analgesic. Among the many writers who have borne witness to its efficacy in this direction, several have distinctly described it as

[1] New Medications. Translated by E. P. Hurd, M.D. The Physician's Science Library. P. 268. George S. Davis, Detroit, publisher.

a substitute for opiates. The following statements of this nature are referred to in Dr. Griffith's article on "General Therapeutics," in the *Annual of the Universal Medical Sciences* for 1889.[1] Fiske[2] reported that one patient, who had used morphia for headache, obtained in antipyrine a satisfactory substitute. Milne[3] adds his testimony to its value in allaying pain and producing sleep, and it has with him almost entirely supplanted opium for these purposes. Wolf[4] recommends it in painful conditions in which it is desired to avoid morphia. Bahnson[5] has used it with success in relieving pain, even in cases where opium had failed. Norton[6] found the relief of pain by it in dysmenorrhœa greater than that afforded by opium and belladonna suppositories.

As to the objections to antipyrine, the principal one is its depressing effect upon the heart when given in large doses. It is therefore contraindicated where the circulation is feeble; and the dose needs to be always cautiously regulated. Its use is also attended at times with other unpleasant symptoms, as cutaneous eruption, gastric disturbance, coryza, etc., which are to be regarded as inconveniences rather than dangers.

My own experience with antipyrine has given me a high opinion of its analgesic powers. Having ordinarily used it in five- or ten-grain doses for an adult, symptoms of depression have been very rare and never alarming; and the other unpleasant effects have been practically absent. Yet even in these moderate doses the effect in relieving pain has been very satisfactory. The cases of a chronic nature, aside from headache, in which it has proved itself efficient have been chiefly neuralgia and rheumatism. The relief has been complete in some cases, and incomplete in others; but the cases in which the remedy has entirely failed have been a very small proportion. Among the many cases of success with antipyrine, in my own practice, the three

[1] In this article by Dr. J. P. Crozer Griffith, of Philadelphia; and also in the article with the same title in the same publication for 1888, by Drs. Pepper and Griffith, are found digests of the several reports upon this and the other new medications rendered during the two years ending January 1, 1889. For later reports see the Therapeutic Gazette for the present year.

[2] Boston Medical and Surgical Journal, July 12, 1888.

[3] Weekly Medical Review, February 4, 1888.

[4] Therapeutische Monatshefte, June, 1888.

[5] North Carolina Medical Journal, July, 1888.

[6] Medical and Surgical Reporter, February 25, 1888.

following are selected because in two of them it was substituted for morphia and proved equally efficacious in relieving pain, and also because it was used for such long periods that there seems to be no room for error. The first is a case of intercostal neuralgia, the second is one of protracted pain from the pressure of a morbid growth upon the brachial plexus, and the third a case of facial neuralgia in which the effect was admirable, notwithstanding a weak heart.

CASE I.—Miss B., aged forty; a neurotic invalid for many years; had been subject for five years, or more, to frequent attacks of intense intercostal neuralgia of left chest. For this she had been accustomed to resort to morphia, which alone would give relief. On March 26, 1888, I saw her in one of these attacks and ordered antipyrine, five grains every four hours. She was, as she expressed it, "wonderfully relieved;" the effect being more prompt and decided than that of morphia. Subsequently, whenever she felt any return of the pain, she would take a few doses of antipyrine and the attack would be aborted. The only severe attack which has since occurred accompanied an attack of acute indigestion in the following May. This also was relieved by antipyrine. The correction of a slight uterine displacement in August was followed by a general improvement of the health, and the neuralgia has not returned since that time. She has taken no morphia since the antipyrine was first prescribed.

CASE II.—Mrs. D., aged seventy-four. Twenty-two years ago this patient suffered an amputation of the left breast for supposed malignant disease. In August, 1886, she began to suffer from pain and numbness of the left hand and forearm, which were at times accompanied with swelling. Pressure upon the nerves was suspected, but nothing could be found in the axilla until more than a year later, when a hard mass was detected high up in the axilla, firmly adherent to the neck of the scapula in front. This has since grown upward, until now a growth of extreme hardness has made its appearance, both above and below the clavicle. For nearly three years this lady was a constant sufferer. Massage and galvanism aggravated the pain, and blisters gave only temporary relief. At the end of a year she had become so worn out with pain that she began to take morphia, one-eighth to one-quarter grain at bedtime. This produced sleep, but caused so much nausea and depression the following day that she took it as rarely as possible.

On January 23, 1888, I began giving her antipyrine in five-grain capsules, three times a day. This gave great relief during the day, but it was still necessary to take morphia at night. The pain now involved the whole arm and shoulder and the suprascapular region. On March 5th, there was numbness of the thumb, index and middle fingers. On March 24th, there was complete anæsthesia of the ulnar side of forearm and hand, with hyperæsthesia of the radial side. Soon after this, all tactile sensation was lost in the hand and forearm, but the deep-seated pain continued. So much dis-

turbance followed the use of morphia that the antipyrine was increased to ten grains, three times a day. With this amount she became so comfortable that the morphia was only occasionally resorted to. She experienced no unpleasant effects from the antipyrine and was very happy to escape the nausea, constipation, and general depression which always followed the use of morphia. She tried several times to discontinue the antipyrine, but found it indispensable; as the pain never ceased unless it was taken. On the 8th of last June the antipyrine had ceased to have any effect, and the pain had become most excruciating. I then began giving her hypodermic injections of morphia, one-half grain at bedtime and one-quarter grain after breakfast. This was continued until June 20th; after which, the pain being less severe, the night injection alone was given, and that in diminishing dose, until June 28th, when the pain ceased entirely and has not since returned. The arm is now completely paralyzed, and without sensation. The nerves are apparently so tightly compressed as to have finally stopped the pain.

The interesting feature of this case consists in the fact that for over sixteen months this patient was kept comparatively comfortable by antipyrine, and was obliged to take but little morphia, which latter drug was avoided, not from fear of the opium-habit, but on account of its disagreeable after-effects.

CASE III.—Mrs. S., aged forty-eight. This lady has an immense uterine fibroid. She had acute rheumatism five years ago, which has left her with a mitral regurgitation. Has been greatly depleted by menorrhagia for many years. In good flesh, but feeble and suffering much from faintness and other heart symptoms. I was called to see her October 31, 1888, on account of a severe attack of facial neuralgia. Antipyrine was given in five-grain capsules, three times a day, from which she obtained prompt relief. She felt no faintness nor increased weakness. Digitalis, which she had previously been taking, was continued at the same time.

This case is mentioned, because it was one in which large doses of antipyrine were contraindicated; and the propriety of giving it at all might be questionable; but the small amount given gave complete relief without any depression.

Acetanilide has already proved itself an analgesic of great value. By Dujardin-Beaumetz[1] it is even placed before antipyrine in this respect; but most other writers give it the second place. It possesses the advantage over antipyrine of being far less depressing and causing no eruption. Its fault is, that in large doses it produces cyanosis; but

[1] De l'Acetanilide (Antifebrin) comme Médicament Sédatif au Système nerveux. Bull. gén. de thérap., 1887, vol. 113, p. 97. Transl. Therap. Gazette, 1887, 3 s., iii. p. 577.

this appears to be less of a danger than a warning against excessive doses. The doses used by myself have usually been five and ten grains; from these neither cyanosis nor any other unpleasant effect has ever resulted. The effect upon pain has generally been less than that following similar doses of antipyrine; and it has latterly seemed best to give seven or eight grains as a minimum dose, instead of five. The chronic cases in which it has shown itself capable of replacing opiates have been rheumatism, especially in the form of lumbago and dysmenorrhœa. In several cases of lumbago its administration was followed by relief as prompt and complete as would have resulted from hypodermic injection of morphia. In dysmenorrhœa, I have given it to several young ladies, whose sufferings had previously been so severe as to require the use of morphia. In all of these, the relief following the use of acetanilide in one or two doses of five or ten grains, has been so prompt and complete as to surprise and delight the patients. Larger doses than these have been given by others with entire safety and a larger degree of success than has attended my own experiments with the minimum dose. Dr. Austin Flint,[1] for example, reports an obstinate case of sciatica not only relieved, but actually cured, in forty-eight hours by doses of forty to fifty grains.

Phenacetine. This remedy, of more recent discovery than antipyrine and acetanalide, has been found by numerous observers to resemble them strongly in its analgesic powers. It appears to be safer than either of these remedies, since it produces neither depression nor cyanosis, unless used in excessive doses. For these reasons it promises to be a valuable addition to the pain-relieving medicaments. My own experiments with this drug have tended to confirm the views of others; but do not yet justify any decided expression of opinion as to its value as a substitute for opium.

Salicylic acid, and more especially its sodium salt, should be included in this list, on account of their favorable action in relieving the pain of chronic rheumatism. Though their effects are less certain and less brilliant in the chronic than in the acute form of this disease, yet they are of marked value in a large proportion of cases. The relief to pain is obtained through their curative influence on the disease—a marked

[1] A Case of Sciatica Treated with Large Doses of Antifebrin. New York Medical Record, Dec. 1, 1888.

contrast to the action of opium—which, though more efficient in relieving the pain, acts otherwise most unfavorably.

Other analgesics of great value are quinine, in neuralgia, especially the malarial variety; cocaine, used hypodermically; galvanism and massage. To these may be added all of those hygienic measures which, by imparting vigor to the system, tend to remove the causes of pain.

To Induce Sleep.

The dangers of opium, when used as a hypnotic, are even greater than as an analgesic; for pain, which is to some extent an antidote to opium, protects the system in part from its toxic influence. In simple insomnia, though often resorted to by the laity, it is rarely used by physicians, but is reserved for those extreme cases where other remedies fail. Until recently, the only drug equalling opium in hypnotic power has been chloral hydrate; but this remedy possesses disadvantages scarcely less than those of opium itself. When, therefore, the milder hypnotics prove ineffectual, we naturally desire some safer remedy than either opium or chloral, but equal to them in power. This wish is at last realized in the discovery of the new hypnotics, paraldehyde, hydrate of amyl, and sulphonal.

Paraldehyde is an excellent hypnotic, apparently as safe as the bromides, free from deleterious effects, though rather uncertain in its action; and only objectionable on account of its unpleasant odor, which is imparted to the breath. My own experience has convinced me that it is a valuable substitute for opium. As an illustration of its usefulness, the following case is selected; because in the last stage of a distressing disease, it produced sleep after opium had been used without success.

Case IV.—Mr. D., aged seventy-five, was attacked in May, 1888, with urgent cardiac symptoms, and was found to have chronic Bright's disease. He was seen by me from time to time in consultation. In the following August his condition had become very distressing; both lungs were congested at the base, there was effusion in both pleuræ, and the dyspnœa was very urgent. He could not lie down, and sleep was almost impossible. All sorts of anodynes were tried without effect; even morphia became useless. On August 22d, he was given paraldehyde in doses of half a drachm every four hours, sometimes increased to one drachm, and sometimes at intervals of two hours, according to circumstances. The effect was delightful; sleep was induced in from ten to fifteen minutes. He was able to lie down, and while

asleep the breathing became much quieter. He would wake refreshed. The heart was not weakened, but, on the contrary, was temporarily strengthened. He died on the 7th of September; but the last sixteen days of his life were rendered quite comfortable by the paraldehyde. The agony of dyspnœa which he had previously suffered gave place to tranquil sleep, with diminished suffering during the waking intervals.

Hydrate of amyl is generally preferable to paraldehyde, being more reliable as well as more agreeable. It is found efficient in extreme cases of insomnia, including those due to the opium-habit. It is also available when a weak heart forbids the use of chloral.

Sulphonal is at present far more extensively employed than either paraldehyde or hydrate of amyl. Its agreeable effects and freedom from taste have already won for it an extraordinary popularity. It is applicable in all forms of insomnia, in insanity, and in the opium-habit. It is nearly free from danger, and induces no habit. It is not, however, free from objections. These have been found by Dr. Griffith[1] to be the following:

1. Slowness of action.
2. Effect prolonged into the following day.
3. Uncertainty of dose.
4. Unpleasant after-effects; which are, mental excitement, nausea, vomiting, dizziness, headache, languor, exhaustion, depression, and a staggering gait.
5. Frequent failure to produce sleep.

This author, while favorably impressed with sulphonal, expresses a decided preference for paraldehyde and hydrate of amyl; especially the latter.

My own experience with sulphonal has been very favorable. No unpleasant effects have been observed, except an occasional languor or drowsiness the following morning. I have also observed an uncertainty in its action; the same patient getting a retarded or imperfect effect on one occasion, and again a very powerful effect from a less dose. I have usually given ten to fifteen grains as an initial dose, and have rarely exceeded twenty, which amount appears quite safe and is ordinarily sufficient.

[1] Remarks on the Unpleasant Effects of Sulphonal. Therap. Gaz., May 15, 1889.

Chronic Diarrhœa.

In chronic, as in acute diarrhœa, it is probable that no remedy has been used more largely than opium. The effects of this mode of treatment, however, are far from satisfactory. Among the veterans of the war, a very large number are still suffering from this disease. From official sources[1] I have learned that there were on September 6, 1889, 63,523 pensioners on the rolls whose disability consists entirely of chronic diarrhœa; and this does not include cases in which pension is allowed for chronic diarrhœa and other disabilities. About one-eighth, therefore, of all the pensioners are disabled by this cause alone. That so great a number of cases remain uncured at this date, more than twenty-four years after the close of the war during which most of these cases originated, is sufficient evidence that their treatment, whatever it has been, has not been attended with success. These men are ill-nourished and feeble; their diet is necessarily limited to a few articles of food, and exhausting attacks of diarrhœa are brought on by any trifling error of diet or change of temperature. These attacks often induce dysenteric symptoms. A small proportion only of these cases are probably at present under active treatment. Many rely upon some special remedy for temporary relief; some have discarded all medicine and try to keep the disease in check by diet alone. As might be expected, some have become opium-eaters,[2] though no such cases have come under my notice. Until recently, it has been my own custom to prescribe opium to some extent in such cases, though in very small doses; but during the past year I have treated these cases antiseptically with far better results. The remedy chiefly used, in my cases, is the sodium salicylate, in five- to ten-grain doses, three or four times a day. Though the number of cases has not been large, the results have been so far very satisfactory. In almost all of the cases the diarrhœa has been checked in two or three days, and the benefit has been more lasting than that following any other treatment. The digestion has improved, a greater variety of food can now be taken, and the various nervous symptoms which are apt to accom-

[1] Letter from the Commissioner of Pensions to Senator Dawes, to whom I am indebted for this information.

[2] Ira Russell, M.D.: Opium Inebriety. Quarterly Review of Narcotic Inebriety, January, 1888.

pany this disease have been greatly relieved. Besides the soldiers, several of my cases have been ladies. In two of these depression of spirits has been a prominent symptom, and the relief to this has been quite remarkable.

Salol has also been used by me with success in chronic diarrhœa.

Naphthalin, which is highly recommended for the treatment of chronic diarrhœa by Henry,[1] Wilcox,[2] Peabody,[3] and others, I have not yet tried.

The antiseptic method, which has been extensively and successfully used in the acute forms of diarrhœa, promises to become equally serviceable in the chronic form. Being entirely safe it may be used experimentally, without hesitation, and the effects thus far render it highly probable that it will prove of great benefit to a large proportion of the many thousands of war veterans who still suffer with this disease.

All of the antiseptic remedies which have proved valuable in chronic diarrhœa may properly be classed among the substitutes for opium.

The two following cases of chronic diarrhœa are appended as illustrations; one of them being an old soldier, and the other a lady.

CASE V.—J. C., aged fifty-four, contracted diarrhœa in the army, and has suffered from it ever since the war. His stools are usually watery; when diarrhœa is relieved the bowels become constipated. He has to be very careful about eating; has grown very thin and weak; has much headache and dizziness; has been treated by myself at times for twenty years, and also by other physicians, with only temporary relief. On February 21, 1889, he came to see me with an unusually severe attack of watery diarrhœa, which had brought on dysenteric symptoms. He had from four to seven stools daily, containing mucus and blood. He had also much pain in the bowels, hips, and legs, with headache. I ordered the sodium salicylate, ten grains four times a day in solution with glycerine and water. He came to see me eight days later, and reported that the symptoms were greatly relieved on the second day. Since then there had been one or two dejections daily, thin, but without blood or mucus; all of the pains had ceased, including the headache. The appetite was improved. He says he has never had any medicine since leaving the army which has affected him as favorably as this. He called again June 15th; he had then had two attacks of watery diarrhœa since March 1st without mucus or blood. Each time he resumed the use of the sodium salicylate and was relieved entirely in three or four days. He

[1] Antiseptic Medication. Transactions Association of American Physicians, vol. iii., 1888.

[2] St. Louis Medical and Surgical Journal, March, 1887.

[3] Boston Medical and Surgical Journal, Feb. 24, 1887.

now has two or three dejections daily which are unformed but not watery. His general condition is much improved.

CASE VI.—Mrs. G., widow, aged forty-five; was first seen by me in August, 1884. She had then suffered for some years with chronic diarrhœa, for which she had been treated without benefit. I gave her pills of nitrate of silver one-sixth of a grain, and opium three-quarters of a grain, three times a day, which checked the bowels for the time being. She was not cured, however, for the least error of diet brought on a return of the diarrhœa, and the movements were always watery. Her diet was restricted of necessity chiefly to bread and eggs. Neither meat, vegetables, nor milk could be digested. There were constant dyspeptic symptoms, emaciation, and great depression of spirits. Whenever diarrhœa returned severely she resorted to the pills, whose proportions were several times changed to find the minimum effective dose of opium, which proved to be one-quarter grain combined with one-quarter grain of the nitrate of silver.

In August, 1888, I gave her the sodium salicylate, five grains in capsule, three times a day after meals. One week later she reported that she had one stool daily of more consistent character than for years. There was much flatulence, however, and the experiment was tried of adding iodoform one-half grain to each capsule. On September 27th, she reported that she was improving, but had occasional slight returns of diarrhœa, and the digestion was not very good. The sodium salicylate alone was thereafter given as at first. I did not see her again until January 28th, when she informed me that she had had no diarrhœa since September 27th. The digestion was better, though still not perfect; she could eat many articles of food which she had not been able to touch for years; she had gained much flesh and strength, and, above all, the depression was gone, and she was in the best of spirits. She had then taken the sodium salicylate continuously for five months. She said she thought, from the exhilarating effects, that it must be a stimulant. Since then her health has been excellent, and there has been no return of the diarrhœa. She has taken no opium nor any other medicine since January.

In bringing this paper to a close, let me say, by way of recapitulation, that we now have remedies at command which may be used instead of opium in many, if not all, of the chronic affections in which this remedy was formerly our main dependence. For producing sleep and for the treatment of chronic diarrhœa, we have at present certain hypnotics and antiseptics which are not only as efficient but so much more satisfactory that we may practically lay opium aside to be used only on rare occasions. As an analgesic opium still stands at the head of the list for promptness and certainty; but the antipyretics which have been mentioned in this paper are capable of replacing it in probably the majority of chronic cases; and the relief which these agents

afford is attended with less disturbance of the system than that which is induced by opium. In rheumatism opiates have been very largely superseded by the salicylates.

In my own practice opium has become a much less important element than it was a few years ago; and this change is attended with great satisfaction to myself, partly because, with other remedies, better results are obtained; and partly because the danger of helping to form the opium-habit is thereby much lessened. Slight as this dreaded danger may be when opiates are prescribed with caution, yet the danger is amply sufficient to cause us to rejoice in the recent valuable additions to the list of remedies which have come to be recognized as substitutes for opium.

DISCUSSION.

DR. ISRAEL T. DANA: I do not think that Dr. Adams has at all exaggerated the frequency of the opium-habit. I do not think it would be possible to exaggerate its pernicious effects. But I do think the medical profession is held too generally responsible for its prevalence. People take up the use of opium of their own accord, just as they do the use of wines and distilled liquors. Some years ago I met with a case in which the habit was induced by a curious and perhaps unique method. A letter was received by the Superintendent of the Maine General Hospital, from a gentleman, saying that he and his wife desired to enter the institution together, to be cured of the morphine-habit. He quaintly added: "We propose to leave off the morphine, or to leave our bones with you." We expected to see an aged couple arrive, but instead, a specially jolly-looking young man and wife appeared. They were using six grains of morphine apiece daily. The husband's habit was formed in this way: Having, months before, administered hypodermic injections of morphine to a neighbor dying of cancer and too poor to command frequent visits from his physician, the syringe and some of the morphine remained still in his possession, when he met with an accident which resulted in fracture of the femur. One day, while suffering pain in the limb, it occurred to him that morphine used to give great relief to the cancer patient, and he resolved, without consulting his physician, to try it for his own pain. The effect was very agreeable, and after a time he thought, "Why can't my wife have a little of this fun, too?" So he began giving it to his wife, who was in perfect health, simply in order that she might have a share of "the fun." In this way she, too, fell a victim to the habit.

DR. G. M. GARLAND: I appreciate the fact that Dr. Adams has not attempted to exhaust the list of substitutes for opium. I therefore do not intend my remarks as a criticism. There is one drug that has served me so well as a substitute that I think that it is worth mentioning in this connection. That is the fluid extract of gelseminum. I have used this for eight or ten years in chronic cases of pain and in neuralgia of certain types, and in certain hysterical cases. In frontal headaches the drug acts admirably. In acute coryza I know of nothing that will relieve the headache so quickly. It is also useful in chronic headaches. A young woman came into the county hospital with headache which had lasted six weeks. She had been under the influence of morphia. I put her on gelseminum, and for the first day added one-sixtieth of a grain of belladonna. The pain was gone in a short time, and at the end of a week she left perfectly well. In the pain of difficult menstruation it acts very well. In some of these cases I have combined it with cannabis indica. Only this last week I had a case of a lady with an hysterical attack just previous to the flow. This time she complained of pain in the cardiac region, with gasping for breath during the paroxysms of the pain. I gave her ten drops of fluid extract of gelseminum, to be repeated every half hour until relief was obtained. The paroxysms seemed to be relieved, and the woman went to sleep from exhaustion.

As is well known, this drug has the peculiar property of producing diplopia and ptosis, and where there is sufficient interval between the doses these signs give ample warning. I am accustomed to give five to ten drops every half hour until we get the physiological effect, or relief is afforded. The mother of the lady to whom I have referred is also neurotic, and suffers from severe neuralgia in the left arm. I treated her in one of these attacks with heavy doses of morphia. One night, after giving her subcutaneously something over two grains of morphia in divided doses, she passed into a condition of collapse, her skin became cold and clammy. She finally came around all right. In the last attack I gave her gelseminum until heaviness of the eyelids was produced. She then passed a comfortable night and went to sleep. As a simple hypnotic it works in some cases of temporary congestion with insomnia and headache. In one case, of a man who had suddenly lost money and had been unable to sleep for several days, gelseminum with galvanism to the head afforded decided relief in the course of twenty-four to forty-eight hours. In hysterical cases with the globus hystericus, gelseminum will often induce sleep in a short time. As the patients express it, "they have to go to sleep." I have never seen any bad effects from the drug in the way of depression of the heart.

In view of the results which I have had, I deem the drug worthy of mention in this connection.

REPORT OF THREE CASES OF REMARKABLY SLOW PULSE,

To which are appended Brief Abstracts of Ninety-one Cases of Slow Pulse found recorded in Medical Journals in the Library of the Surgeon-General's Office, Washington, D. C.

By D. W. PRENTISS, M.D.,
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Case I. *Remarkable case of slow pulse extending over a period of nearly two years.*—G. W. P., white, male; carpenter, aged fifty-four years. Father died of cystitis (enlarged prostate?) at the age of seventy-five years. Mother died of cancer at the age of forty-five years. Has himself always been healthy; almost never lost time from his work on account of sickness. The only illness he remembers was neuralgia of the stomach, fourteen years ago. Has received no injuries except a fall when nineteen years old—fell on his feet about a distance of fifteen feet; suffered no bad consequences—and ten years ago a piece of brick fell on his head, cutting the scalp, but causing no serious injury. Never had any form of venereal disease. Has always been temperate in regard to the use of alcoholic stimulants, but not so as to the use of tobacco—smoking a pipe almost constantly when opportunity offered. I have been his family physician for sixteen years. During this time was never called upon to attend him personally until the present illness, which began December 13, 1887. He had been building a house down in Maryland, in a malarial locality, when he began to have "weak spells," and finally, upon lifting heavy weights, on several occasions he fainted. Becoming alarmed, he returned home, and I was sent for. At this time I could find no well-defined disease. He was weak and depressed, tongue clean, no fever, mind clear, pulse 36. There is no reason to think there had previously been anything abnormal about his pulse. Urine normal. Bowels constipated. Examination of the heart discovered no organic disease. The systole was full and strong, and the diastole greatly prolonged.

The following is the record of pulse and treatment from December 13, 1887, to June 20, 1888:

December 13. Pulse 36. Tr. digitalis, strychnine, iron and quinine, and belladonna ordered.

14*th*. Pulse 26. Digitalis stopped. Carb. ammon.; hyoscyamus and camphor. Digitalis was stopped on account of producing alarming faintness.

15*th*. Pulse 36.

20*th*. Pulse 30.

23*d*. Pulse 26.

24*th*. Pulse 27.

26*th*. Pulse 22.

27*th*. Pulse 24.

30*th*. Pulse 26. Dr. W. W. Johnston in consultation.

January 3, 1888. Pulse 28. Faradic current applied to chest and back of neck. When one pole was applied to neck under one ear it caused dizziness and faintness.

6*th*. Pulse 39.

13*th*. Pulse 60.

20*th*. Pulse 76.

He had been ordered to stay in bed, but when he felt better he got up and started down stairs. Was seized with fainting spells, in one of which he was on the stairs, and fell down stairs; in another, fell out of a chair; was unconscious about one minute. After January 20, 1888, when pulse had risen to 76, he had no more fainting spells, but continued to convalesce slowly, and in March was able to resume work. He was cautioned about over-exertion and heavy lifting, and specially not to use tobacco in any form. He could not, however, resist the temptation to take an occasional smoke. He continued to work at intervals during the summer until October (1888), when he had a relapse, coming on with the same symptoms as the first attack.

The following is the clinical record from October 2, 1888 to April 15, 1889:

October 2, 1888. Pulse 36. Faint sinking spells. Chills.

3*d*. Pulse 24. Quinine 0.60 each morning.

8*th*, 9 A.M. Pulse 24.

9*th*, A.M. Pulse 18. Nitroglycerine, 1 per cent., 2 drops every 3 hours.

10*th*, A.M. Pulse 26. Iodide and bromide of potassium.

11*th*. Pulse 30.

12*th*. Pulse 28. Complains of "burning throughout the bloodvessels." Stop nitroglycerine. Pulse has been as low as 20 per minute.

14*th*, A.M. Pulse 26. Nitrite of amyl, if necessary. Pills of strychnine, belladonna, caffein.

19*th* A.M. Pulse 20. Pulse 24 since 19th.

23*d*, A.M. Pulse 18. No pills since Sunday.

26*th*, A.M. Pulse 32. Dr. A. E. Johnson visited him. Fainting spells.

November 14, A.M. Pulse 37.

17th, A.M. Pulse 44.

24th, A.M. Pulse 36.
29th, A.M. Pulse 36.
December 10, A.M. Pulse 36.
16th, A.M. Pulse 40.
26th, A.M. Pulse 38.
January 1, 1889, A.M. Pulse 40. Spells. Strophanthus. Bromide of ammonium.
2d, A.M. Pulse 32.
3d, A.M. Pulse 36.
10th, A.M. Pulse 32. Spells every day, but generally better.
17th. Pulse 42.
24th. Pulse 40 to 60. Weaker. Delirium at times.
31st. Pulse 40. No spells. Sometimes delirium. Not as weak. Takes food.
February 9, A.M. Pulse 36.
17th, A.M. Pulse 30. Seems improved.
24th, A.M. Pulse 32. Flashes of heat around heart.
March 3, A.M. Pulse 34.
10th, A.M. Pulse 36. Better.
17th, A.M. Pulse 44. Sitting up.
24th, A.M. Pulse 18. Bad fainting spells. Black in face.
28th, A.M. Pulse 20.
29th, A.M. Pulse 36.

FIG. 1.

Taken March 29th. Pulse 36.

31st, A.M. Pulse 38.
April 1, A.M. Pulse 15.

FIG. 2.

Taken April 1st.

8th, A.M. Pulse 15.
15th. Pulse 38.

Improved so that he sat up, and could go around the house and out for short walks. No attempt to work.

About August 1, began to have a return of old symptoms.

August 5. Pulse 34; *6th*, pulse 36. For a week had had frequent spells, with partial unconsciousness and dyspnœa. Pulse down to 12 or 15 during spells. Once fell down stairs. Bromide of ammonium.

10th. Pulse 13; temp. 97°. After August 10th no more "spells." Pulse regular and strong, not double. Sweating freely.

11th. Pulse 13; temp. 95°. Confined strictly to bed, and put on diet of

boiled milk, Mellin's food, and lime-water. Whiskey and camphor as stimulants. August 11th had two spells.

12th. Pulse 14; temp. 97.2°. More comfortable, no spells, appetite good, sleeps well, bowels regular, urine free.

13th. Pulse 13; temp. 95°.

14th. Pulse 12; temp. 96°. Feeling better. Respiration slow but normal.

15th. Pulse 13.

16th. Pulse 38; temp. 96.5°.

17th. Pulse 16; temp. 95.8°.

19th. Pulse 36; temp. 98°. Pulse at one time, after turning over in bed, up to 66.

21st. Pulse 46; temp. 98°.

23d. Pulse 36; temp. 97°.

25th. Pulse 34; temp. 97.5°.

September 10. Pulse 34. Unconscious attacks have ceased. Still slight spells of faintness. Sitting up down stairs.

13th. Pulse 34; temp. 96°.

16th. Pulse 32; temp. 97°.

18th. Pulse 18; temp. 94.5°.

These spells are described as follows: They come on suddenly, without warning, often without apparent cause, sometimes following some exertion. He faints, losing consciousness. He describes the sensation as one of utter helplessness as they attack him and as he comes to himself when they pass off. They last from a few seconds to half an hour. The breathing is gasping and slow, as in dying, and consciousness returns with a long-drawn breath. There is a drawing of the muscles of the arms and neck, as in stretching and yawning, but no convulsive movements. Face and hands become pale and then dark purplish. There is no pain, but great exhaustion. Says himself they are due to "stoppage of the heart." Has great confidence in the bromide of ammonium, which he thinks stops the attacks.

During the time his pulse was slowest, from 12 to 16, these spells were recurring almost constantly, and his wife described the condition as "terrible." She worked over him faithfully, with whiskey and camphor internally, mustard and rubbing externally, and nitrite of amyl by inhalation; but thought many times that he was dead, with the black face, gasping respiration, and pulse that seemed at times to stop entirely. She had learned to count the pulse, and she was certain that during the spells it was often much slower than I have recorded.

The treatment of the case from the first has been: rest in bed, tonics and stimulants, electricity, and bromide of ammonium, together with supporting diet. The tonics used were: Iron, belladonna, quinine and strychnia.

		Gm.
℞.—	Strychniæ	0 04
	Ext. bellad.	0.20
	Ferri pyrophos.	3.00
	Quin. hydrochlor.	3.00

In 20 caps. S. One three times a day after food.

These capsules were taken nearly constantly while he was under observation. The stimulants used were whiskey, camphor, and coffee. Digitalis was tried, but made him distinctly worse. Nitroglycerine seemed to help for a few doses, but later caused distress. Convallaria and strophanthus were tried with like result. Nitrite of amyl was useful during the paroxysms in restoring consciousness. The form of electricity employed was the faradic current, one electrode over the heart and the other to the back of the neck. It seemed to be of decided benefit. The drug, however, which appeared to be of most benefit was bromide of ammonium, given in doses of 1 gram three times a day, and extra doses when paroxysms threatened. He appreciates the relief from this medicine so much that he is not satisfied to be without it.

NOTE.—*October* 4, 1889. At the request of Dr. S. W. Mitchell, when this case was presented to the Society, I had an examination made of the eyes.

Dr. W. K. Butler was kind enough to do this, and the following is his report:

"No external changes; muscular action good. Pupils react both to light and accommodation. No change in the fundus; veins and arteries of normal calibre. Slight venous pulsation. Disks normal. Field of vision approximately normal. Both eyes the same. Degree of vision not taken, but apparently good, as ophthalmoscope shows but slight refractive error."

Pulse was taken at this date, standing, sitting, and lying, and found the same for each position.

By a curious coincidence, on the day the foregoing report was read before the Association, an old gentleman presented himself to be examined by the members on account of a slow pulse. He was examined by several of those present, and his pulse found to be between 32 and 36 per minute. At my request he came to my office a few days later for more careful inspection. The following is the report of the case as given by himself:

CASE II.—J. T. S., aged eighty-three years. Nativity, New Lebanon, N. Y. Born 1806. Father died at the age of fifty-five years; cause not known. Mother at age of twenty-one years, died of consumption. No brothers nor sisters. To sea at seventeen years, for four years. Was one month old when mother died. Left New York for the West, Michigan, in 1831. Was in the Black Hawk War in 1832, for thirty or forty days. In 1833 had bilious fever, and after that fever and ague for a year. In good health from then until 1861, when he had a faint attack while working hard. Was in Kenosha from 1841 to 1865, in the express business. Frequent spells of fainting or dizziness, and finally fell in one, in 1864. Did not entirely lose consciousness. At first, spells once in six or eight months. In 1864, from over-exertion, fell. Attack did not last more than one or two minutes. On one day had fainting spells

every hour. Pulse natural up to 1862. After that gradually became less, until in four or five years it was 36, and has remained so. Never had syphilis. Now in excellent health. Does not have fainting spells more than once a year. Has been hard of hearing for fifteen years. Never headache. Suffers much from cold. Keeps close to fire in winter. Goes out but little. Heart: Valvular sounds normal; systole irregular—sort of double or treble sound, diastole prolonged. Bowels regular. Digestion good. Sleeps a great deal. Temperature under tongue 96°. Respiration 20. Pulse the same sitting or standing. Has been married three times—the last time three years ago, at the age of eighty years.

FIG. 3.

Sphygmogram, taken by Dr. R. T. Edes, Sept. 26, 1889.

NOTE.—While preparing this report for the printer, still another case has come under observation in my own practice.

CASE III.—Mrs. F., aged seventy-five years. General health has been good, excepting attacks of faintness and vertigo, to which she has been subject for three or four years. She can feel them coming on with a buzzing noise in the ears. If standing, and not able to get to a seat quickly, she falls with a momentary unconsciousness. I have been consulted about them on several occasions, and directed special care about the diet and regulation of the bowels. Had not noticed any unusual slowness of the pulse until the present attack, which came on with a spell of unusual severity, October 1, 1889, at midnight. She said things looked black, had sick stomach and gagging, dizziness, faintness, and short of breath, but not unconscious. Felt effects all night, and remained in bed next day, complaining of severe backache.

October 2, 1889. Pulse 35.

3*d*. Pulse 35.

4*th*. Pulse 35.

5*th*. Pulse 34.

7*th*. Pulse 36. Sitting up.

Heart sounds normal, except slight blowing sound with systole. Radial pulse and heart-beat correspond. Treatment:

℞.—Potas. bromidi		12
Spts. æth. co.		25
Syr. limonis		25
Aquæ	ad	100

S. Dessertspoonful in wineglassful of water every four hours, and arom. spt. of ammon., teaspoonful as required for a stimulant.

She is still under treatment; improving.

The most interesting question in these cases turns upon the pathology—What is the cause of this retarded action of the heart? I believe that it is a condition of rare occurrence, although in looking up the literature of the subject I have found a large number of cases reported under the title of "slow pulse," some of which correspond in many particulars with the one here presented.

The causes which produce slow pulse may be classified as follows:

1. Diseases or injuries to the nerve centres, producing either irritation of the pneumogastric or paralysis of the sympathetic (accelerator) nerves of the heart.

2. Disease or injury of the pneumogastric nerve, increasing its irritability.

3. Disease or injury of the sympathetic nerves of heart, paralyzing them.

4. Disease of cardiac ganglia, by which the influence of the pneumogastric nerve preponderates.

5. Disease of the heart muscle (degeneration), whereby it fails to respond to the normal stimulus.

6. The action of poisons, as lead or tobacco, either on nerve endings or on nerve centres. The poison generated in salt fish (Case 60). Also the poison of certain febrile diseases; algid pernicious fever (Case 57).

In the present cases it is difficult to say even at this late stage to which of these divisions they belong. There are no symptoms to indicate any form of disease of the nerve centres. There is no evidence of disease in the nerves themselves, nor have we been able to discover any organic heart disease that might account for the symptoms. We have left, then, only the action of certain poisons; and the question presents itself, whether, in the first case, the conditions here found may not be the result of tobacco poisoning from excessive smoking. This appears to me to be the most plausible explanation. Another possibility is malarial poisoning. When the attack came on he was working in a very malarial district, and in the summer of 1888 he had intermittent fever, which was relieved by quinine. These considerations make it probable that we have a paralysis of the accelerator nerves and not an irritation of the vagus.

The symptoms presented in the case are those due solely to the defective circulation. The syncope attacks were the result of insufficient

blood-supply in the brain, and if long continued must result in serious alterations of the nerve centres, as well as of other organs, more particularly of the heart itself, by interfering with its nutrition.

In many of the cases collected in connection with this report, the pathological appearances were a result of the slow pulse, rather than the cause.

In looking up the literature of "Slow Pulse" in the Library of the Surgeon-General's Office, I find it more extensive than I had anticipated. And I wish here to pay a tribute to this magnificent library and its admirable management for convenience of consultation. Without its *Index-Catalogue* it would have been simply impossible for me to have brought together the cases, of which short abstracts are here appended.

The whole number of cases given in abstract is ninety-one. The following is a brief summary according to the supposed causes or pathological conditions:

1. Autopsies are given in 27 cases (Nos. 4, 7, 8, 10, 18, 21, 22, 23, 24, 25, 28, 29, 30, 31, 32, 33, 35, 37, 38, 39, 45, 47, 50, 78, 86).
2. Disease of the brain, 8 cases (4, 24, 27, 38, 39, 45, 67, 81).
3. Disease or injury of cervical vertebræ, 11 cases (7, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37).
4. Epilepsy, convulsions, 7 cases (15, 20, 22, 46, 59, 87, 90).
5. Heart disease, 9 cases (18, 25, 47, 48, 50, 70, 75, 78, 93).
6. Ossification of aortic valves and coronary arteries, 3 cases (8, 10, 21).
7. Starvation and exhaustion, loss of rest, convalescence, 3 cases (13, 14, 94).
8. Lead poisoning, nervous shock, pernicious fever, 3 cases (28, 53, 54).
9. Poisoning by salt fish (?), 1 case (60).
10. Cholera morbus, indigestion, 3 cases (73, 77, 84).
11. Acute febrile condition, 4 cases (40, 41, 42, 88). Also nine cases of slow pulse in fever referred to by Drs. Halpin and Mease, *Dublin Med. Journal*, xiii., February, 1849.
12. Pericarditis, 2 cases (17, 91).
13. Cerebral syphilis, 2 cases (6, 54).
14. Rheumatism, 1 case (79).
15. Sunstroke, 1 case (5).
16. Not given, 35 cases.

The slowest pulse recorded was in Case 79—3 per minute for several hours. In Case 83 it fell to 4 per minute for four minutes, during an attack of syncope, and once it did not beat for 35 seconds and again for 25 seconds. The next slowest pulse was 7 per minute, in Case 36. In Case 3 it fell to 9 per minute.

In reviewing these cases of slow pulse it is evident that the pathological conditions are very diverse, but they can probably all be referred to one or the other of the five classes given above.

Dr. A. Flint, in his article upon the subject in the *Am. Practitioner*, vol. xiii., 1876, very appropriately divides them into two varieties, namely:

1st. Functional slow pulse.

2d. Organic slow pulse.

Organic slow pulse, including all cases in which organic changes, principally of the nerve centres or the heart, are evident during life or demonstrated by autopsy.

Functional slow pulse, embracing all cases in which no such lesions can be found.

It will be evident at a glance at the summary given above that nearly one-half of the cases belong to the "Functional" division. This fact has a special significance because it is equivalent to a confession that in nearly one-half of the cases we are ignorant of the true cause of the condition. The same, however, is true of many very common diseases to which we give a name from certain groups of symptoms, as smallpox, measles, yellow fever, etc.

On the same grounds, perhaps, "Functional slow pulse" may deserve the dignity of a name as a distinct disease. A large number of the cases correspond very closely in their clinical history with the case which has given a text for this paper.

Symptoms of Functional Slow Pulse:

Prodromes of malaise, weariness and exhaustion.

Fainting fits with momentary unconsciousness.

The pulse becoming slow from a minimum of 4 per minute to 40 per minute, averaging from 18 to 40 per minute.

The fainting fits keep pace in frequency and severity with the low rate of pulse.

The attacks are remittent in character, lasting from a few days to

several weeks, then remitting for a similar interval, to return with increased severity.

The course here outlined continues until the individual dies in a syncopal attack more severe than any preceding, from utter failure of the heart to propel the blood through it. No organic disease can be detected to account for the slow action of the heart. The symptoms observed are the result of the deficient circulation, and many of the appearances found at autopsy are from the same cause—especially where the case has been prolonged.

Treatment is purely symptomatic and thus far has not been encouraging. Prognosis is unfavorable; in the cases recorded, all, or nearly all, have terminated fatally, death occurring from sudden syncope. The pathology is entirely in the dark, but further study into the functions of the cardiac nerves and ganglia in their relation to the heart muscle promises to throw most light on the subject.

It is possible that "Functional slow pulse" may be a disease of the cardiac ganglia. Closely allied to the function of the cardiac nerve supply also, is the question of functional rapid pulse, incidentally referred to in this paper.

CASE IV. 1793. *History of a case in which there took place remarkable slowness of the pulse. Pulse down to* 9 *per minute.*—Man, fifty-four years, laborer. Had fallen senseless in the street.

May 16, 1792. Pulse 24. Exhaustion, fainting, and convulsive attacks.

17*th*. Pulse 23.

18*th*. Pulse 26.

19*th*, A.M. Pulse 10; strong and regular. Constant sickness and faintness.

19*th*, 3 P.M. Pulse 9.

19*th*, 7 P.M. Pulse 9.

Died on the 20th. Autopsy: Two ounces of watery fluid found in the ventricles of the brain, a gelatinous appearance in some parts of the pia mater. No other cause assigned for the slow pulse.—*Medical Commentaries* (Duncan), Edin., 1793, p. 458.

CASE V. 1808. *Singular case of disease attended with retarded pulse.* (Dr. Malachi Foot, of New York, for Dr. Orchard Gould, Branford, Conn.)—June, 1808. John Smadley, aged twenty-four years. After three days' prodromes of oppression to breathing, sighing respiration, and debility, there was loss of vision and then loss of consciousness. Came on after mowing grass on a warm day, and drinking freely of water. [Sunstroke?] Pulse, for ten days, from 14 to 30 per minute. Treated by bloodletting. Recovery in two weeks.—*Medical Repository*, N. Y., 1809, p. 138.

CASE VI. 1825. *Case of epilepsy with remarkable slowness of pulse.* (Wm. Burnett, M.D.)—Naval officer, aged forty-six years. Occasional attacks of epilepsy for twelve years, up to four years ago, since which time none until the present.

August 23, 1820. Return of paroxysms.

Treatment: Moderate bloodletting, local and general purgatives, tonics, and *small doses of pil. hydrarg.*, checked them.

January 27, 1821. Return of attacks very frequent, four or five in half an hour, nausea, drowsiness, etc. Same treatment.

April. Attacks have been lighter, but complained of uneasiness and distention at epigastrium, and dyspnœa. In bed; pulse 36, regular and small. Next day, pulse 20, and from that time until May 6th, from 28 to 56 per minute.

July 2. Pulse 56. Great languor, uneasiness, and fulness about the epigastrium.

3*d.* Had a bad night, nausea, vomiting, and slight attacks of epilepsy. Pulse 24. No headache. Camphorated mercurial ointment and pills of blue mass and colocynth.

9*th.* Had several slight attacks. Pulse 52. No specific effect from mercury.

16*th.* Has had slight attacks. Pulse 20.

17*th.* Pulse 18.

20*th.* Pulse 14.

21*st.* Pulse 14. Slight paroxysms.

22*d.* Pulse irregular. Paroxysms frequent and severe. Pulse ranges from 24 to 74. Stops during paroxysms, sometimes seven, eight, or ten seconds.

24*th.* Pulse 18 to 16.

August 2. Pulse 24.—*Medico-Chir. Trans.*, 1825, p. 202.

[NOTE.—This was probably a case of cerebral syphilis.—D. W. P.]

CASE VII. 1835. *Remarkable slowness of pulse in a horse.* (Reported by Mr. Pope in the *Veterinarian.*)—October 17, 1835. Mr. Pope was called to see horse belonging to Mr. Ruxton Hill, of Fiddes, Feveran. Pulse was found to be only 10 per minute, with a strong bounding rattle which made the whole chest shake so that it could be seen at a distance. The heart at times ceased beating and the horse fell down. The veterinary not knowing the nature of the disease, the horse was bled, given laxatives every second day, a seton inserted behind each ear, a rowel in the chest, and this treatment continued for a fortnight, when he gradually fell off his feed. In consequence of this the laxatives were stopped, and the pulse rose to 25. As, however, the horse was growing worse, and continued to fall down, it was decided, in consultation with other veterinarians, that the case was hopeless, and he was killed.

Autopsy.—The disease proved to be dropsy of the spine in the situation of the cervical vertebræ. On opening the spinal canal at the first and second vertebræ a considerable quantity of water flowed from the neck—evidently

from the spinal cavity. The brain and all the internal organs appeared quite healthy.—*London Medical Gazette*, vol. xx., 1837, p. 254.

CASE VIII. 1838. (John R. Gibson.)—Mr. W., aged seventy years. Temperate. Always in good health, excepting fits. Slight fit twenty years ago. Swimming in the head, coming on suddenly, coldness of extremities. For last eight years fits more frequent, coming on without apparent cause.

July 29, after attack of indigestion, had a fit. Pulse 22, full and firm. No pain nor uneasiness about head. A purgative and an alkaline mixture were ordered.

August 2. Pulse 17. Had many fits during the day. No heart disease could be detected.

Description of "fits:" If slight only, face became pallid, respiration rather labored and quicker than natural. No pulse, but directly the heart acted the pallor rapidly gave way to a blush, and all was as before. If severe, the pallor increased, the expression became ghastly, the eyes turned up; involuntary twitchings; respiration quick and labored, with the alæ of the nose violently drawn in at each inspiration, producing a peculiar noise; surface cold, perfect loss of sensation, volition, etc., and sometimes involuntary discharge of feces and urine. The heart was not acting, and I observed for more than half a minute, when no stroke whatever could be detected. If a feeble action of the heart only took place, such as could scarcely be felt at the wrist, the symptoms would continue; but directly a decided contraction occurred the face would immediately change from pallor to redness. Then a suspension to the breathing in which the hand would be raised to the throat; an apparent state of strangulation existed for the moment; sensibility immediately returned. The pulse then beat steadily for five beats at the rate of 60 in a minute; and he would always, without exception, conceive that he had been asleep.

3d, 1 P. M. Pulse 17; irregular and intermittent.

9 P. M. Pulse 16.

4th. Expired in a fit.

Autopsy.—Brain congested, but otherwise healthy. Cartilages of ribs completely ossified; right pleura healthy; left pleura adherent; no liquid in pleural cavities; pericardium healthy; aorta dilated; heart rather large; cavities and valves healthy, except a spot of ossific matter at the base of one of the mitral valves, which in no way interfered with its function. Coronary arteries: some yellowish spots were observed between the middle and inner coats, and in left coronary artery was a very small spot of ossific matter. In the interior of the aorta were very many yellowish-white spots, in some places forming patches. In one spot, the size of a sixpence, was a softened and ulcerated surface; in another complete ossification.

At bifurcation into iliacs, complete ossification; not, however, including the whole circumference of the vessels. The internal coat was destroyed on the surface of this ossification, so that it projected into the cavity of the artery. The aorta was very little diseased at its upper portion, but this increased as

the vessel lengthened. The branches of the left internal iliac were completely ossified. The omentum was largely loaded with fat.

Intestines healthy, but mesenteric vessels seen most beautifully encircling them; "nutmeg" liver; openings of hepatic veins unusually large; kidneys contained cysts; other organs not described presented nothing unusual.

In the discussion of this case, Mr. Gibson is clearly of the opinion that the fits were a result of the stoppage of the heart's action, and not the cause. He considers the disease of the aorta, as shown at the autopsy, to have been the cause of the slow pulse, and proceeds to discuss the question at considerable length.—*London Medical Gazette*, vol. i., 1838 and 1839, pp. 123 and 155.

CASE IX. 1838. (Herbert Mayo, F.R.S.)—Mrs. T. H., aged thirty-five years. For fourteen years pulse has been slower than normal, from 38 to 42 per minute. Otherwise in fairly good health.—*London Medical Gazette*, vol. xxii. p. 232, N. S.

CASE X. 1838.—Clergyman; died at age of thirty-two years from obstruction of the bowels. Previous health remarkably good. Was an athlete. Could climb hills, run, etc., without trouble. Pulse 32, otherwise normal. At the autopsy the aortic valves showed commencing ossification. (*Idem.*)

CASE XI. 1838.—Man, sixty-seven years of age. Pulse 28 or 29. Health good. When pulse reaches 36 feels very unwell. (*Idem.*)

CASE XII. 1838.—Man, aged seventy. Pulse 38 to 40. Oppression of chest, swelled legs, sense of fluttering in head. Recovered under antispasmodics, and pulse came down to 28, regular. Symptoms of brain trouble later. (*Idem.*)

CASE XIII. 1838.—Case of young lady. Neuralgia of face and throat. Was denied food by the stomach. Fed by rectum. After the lapse of five weeks, pulse, from 70 to 80, dropped suddenly to 35. Food was given by the mouth and she gradually recovered. (*Idem.*)

CASE XIV. 1838.—A surgeon. After loss of six nights' sleep, without rest during day, pulse fell to 30 for a day or two, then rose to 40; but many years elapsed before it got back to 70. (*Idem.*)

CASE XV. 1838.—Man, aged fifty-two. Full habit. Epileptic seizures, with transient giddiness. Pulse 70 to 80. Subsequently, after repeated attacks of giddiness, the pulse fell to 34, 30, and as low as 27. There was ventricular disease. At a later date condition continued the same. (*Idem.*)

CASE XVI. 1838.—A physician, aged sixty-two. Up to fifty-nine years of age health good, with only two interruptions, one of severe headaches, the other influenza, for which he was bled. This was followed by extreme weakness of body and mind, and a year later the pulse fell to 30. After vomiting it became normal. The next day slow pulse returned and never after resumed its normal frequency. Stimulants had no effect upon it. (*Idem.*)

CASE XVII. 1838.—Case at Guy's Hospital. Man, forty years old. Outpatient. Embarrassment of respiration supposed to be due to water in the pericardium. Pulse 29 to 14. Recovered entirely in two months. (*Idem.*)

CASE XVIII. 1840. (W. C. Worthington, Senior Surgeon Lowestoft Infirmary.)—Man, aged between forty and fifty years. Pulse in health 75 per

minute. Became afflicted with dyspnœa, oppression about chest, great prostration. Pulse 40, sometimes less. No valvular disease of heart. Symptoms gradually increased for two or three years until he died, in an unusually severe attack of dyspnœa.

Autopsy.—Heart found imbedded in fat, its structure blanched and softened so that the finger could easily be pushed through its substance; valves normal. Superior and inferior cavæ and right auricle distended with dark blood.—*Lancet*, 1840–41, ii. p. 336.

CASE XIX. 1840. (By same writer.)—Man, aged seventy years. Normal pulse 70. Pulse at this date 26. Attacks of dyspnœa for three years. Heart's action feeble and irregular. During fainting fits powerless. Dyspnœa. Pulse feeble.

In the two previous cases no disease of the base of the brain was suspected.

CASE XX. 1840.—Man, aged sixty years. Attacks simulating epilepsy. Pulse 17 to 23. No injury to head or neck.—*Lancet*, 1840–41, i. p. 892.

In discussion at the Royal Medical and Chirurgical Society, March 9, 1841, it was suggested that slow pulse might be due to disease of the arteries. Also that it might be due to defective circulation in the brain.

CASE XXI. 1845. (*Lancet*, vol. ii., 1845, p. 451.)—W. C. Worthington, F.R.C.S., Senior Surgeon Lowestoft Infirmary, refers to a case reported five years before (*Lancet*, vol. xl., p, 336.), a gentleman, seventy years old at that time. Pulse 28 to 30. Was still living up to August previous. In good health except old age. No sign of cerebral disease. Pulse never exceeded 30. A few months before death, fell and fractured his leg, from which he never recovered.

Holberton endeavored to prove that slow pulse was due to disease of the medulla oblongata. Worthington differs from this opinion; says that slow pulse occurs independently of disease of the medulla. That it is due to insufficient or perverted nutrition of the substance of the heart, arising from ossification of the coronary arteries. Thus slow pulse may be regarded as a symptom of this condition.

A case is mentioned in which the pulse was 40. After death the heart was found imbedded in fat, its structure generally blanched and softened, so that its substance could easily be penetrated by the finger. Abdominal walls fatty; large quantity of granulated fat in the omentum. Liver congested. Spleen healthy. Kidneys slightly enlarged and

granular. Large cysts of left kidney. Pleura normal. Lungs emphysematous. Pericardium healthy, containing three to four ounces of transparent serum; not adherent to heart. Heart twice its normal size; surface pale. Pulmonary artery and valves healthy. Right ventricle dilated and containing a fibrinous concretion. Walls slightly thickened but not much altered in consistence. Tricuspid valves healthy. Aorta natural size—three inches from its origin was deposited a patch of ossific matter. Left ventricle dilated, thickened and of a pale ash color, soft and pliable. Mitral valve healthy. The two auricles dilated and containing fibrinous concretions. *Coats of the coronary arteries converted into bone for about two inches from their commencement, and were of a dense structure farther on, more or less obstructing their canal.*

Encephalon: Dura mater adherent to inner table of skull. Longitudinal sinus slightly thickened and devoid of blood. At the base of brain was an effusion of about a tablespoonful of serum. Around and in front of the pons Varolii, the pia mater was slightly injected and filamentous threads of recently formed lymph, easily torn, were observed to pass between different parts at this situation. The left branch of the basilary artery was dilated and its coats thickened. The substance of the brain not changed in color. Ventricles of brain did not contain more serum than usual. Choroid plexus pallid. Cerebellum healthy.

Lancet, vol. i., 1845, p. 321. (T. Wilkinson King.) Cases of slow pulse, illustrating the dependence of the respiration on the summit of the spinal marrow, with some reference to the use of a safety valve.

Some lesions of the upper end of the spinal cord, the only known cause of slow pulse. T. Wilkinson King, Esq., F.R.C.S.E.

Dr. Whytt reports a case of remarkably slow pulse in second stage of acute hydrocephalus.

Andral says the pulse of apoplexy is slow; that of brain softening sometimes slow, sometimes fast. Pulse of narcotic poisoning (opium) and of jaundice slow. Is not aware that any disease of the heart produces slow pulse; mentions 86 cases of heart disease in none of which was there slow pulse.

CASE XXII. 1845.—Thomas K., aged forty-five. Rheumatic gout. Facial palsy for three years. Fits like epilepsy for eighteen months. Pulse 22 to 30. Chest oppression, orthopnœa, and palpitation. Bending the head quickly forward induced pricking in every part of the body. Bright, p. 270.

Dura mater at base of brain remarkably carbonaceous. Heart twice its natural size, feeble, and thin.—*Lancet*, vol. ii. p. 451.

CASE XXIII. 1845.—Morgagni records the case of a merchant who, after mental troubles, had vertigo and convulsions. Pulse strong, slow and full, two-thirds less in frequency than normal. Heart found dilated. (*Idem.*)

CASE XXIV. 1845.—Girl, six years. Headache, and right side convulsed. Pulse 30 to 40. Hydrocephalus and tubercles in left cerebrum anteriorly. Abercrombie, p. 128. (*Idem.*)

CASE XXV. 1845.—Groom, forty-nine years. Subject of headache. Had received blows on head. Ailing for nine months, giddy, wandering, drowsy. Pulse 36 to 42; later 44 to 78.

Autopsy.—Great emaciation. Sloughing of nates. Brain adherent at right temple and indurated in spots the size of a bean. Heart small; right ventricle thin; valves normal. Bright, p. 355. (*Idem.*)

CASE XXVI. 1845.—Worker in lead. Stupor, wandering of mind, strabismus, general paralysis. Bright, p. 371. (*Idem.*)

CASE XXVII. 1845.—Man fell from tree on his head. Head symptoms, difficult deglutition, and stertor. Pulse 38. Recovered in three weeks. (*Idem.*)

CASE XXVIII. 1845.—Child, sixteen months. Injury to nucha. Remarkably slow pulse. Paralysis. Convulsions. Died in fit. Abscess at summit of medulla. Abercrombie, p. 101. (*Idem.*)

CASE XXIX. 1845.—Man, forty-seven years. Fracture between fourth and fifth cervical vertebræ. Pulse 48. Respiration 13. Mind clear. Survived seven days. (*Idem.*)

CASE XXX. 1845.—Man, twenty years. Fifth cervical vertebra fractured by a fall. Complete palsy below. Pulse between 40 and 50. Lived three days. Ollivier, Obs. 9. (*Idem.*)

CASES XXXI AND XXXII. 1845.—Dupuytren mentions two cases of fatal injury to cervical medulla artended by slow pulse and phrenic respiration. *Lecons Orales*, tome i. p. 470. (*Idem.*)

CASE XXXIII. 1841.—Man, thirty-three years. Fall. Neck deformed, stiff and painful. Pulse 30. Died on twelfth day. Luxation found between fourth and sixth cervical vertebræ.—*Medical Gazette*, May, 1841.

CASE XXXIV. 1841.—Man, thirty-three years. Fall. Limbs palsied. Pulse and respiration slow. Luxation between fifth and sixth cervical vertebræ and softening of the medulla.—*Medical Gazette*, 1841.

CASE XXXV. 1845.—Marquis de Causan. Gradually palsied over two years. Pulse 30 to 40. Respiration slow. Induration of cervical medulla. —*Lancet*, vol. ii. p. 45.

CASE XXXVI. 1845.—Man, sixty-four years. Fall. Neck injured. Almost helpless. Stiffness for three years after accident. Pulse previous to injury, 60. Fainting fits; pulse 25 to 33. Gout, costiveness, dyspnœa. Later, pulse ranged down to 20, 15, 12, and even 7 per minute, while still conscious. Two or three attacks of syncope daily. Died in syncope five years after injury.

Autopsy.—Heart found large and weak. Lining of ventricles thickened. Mitral opening admitted three fingers. Cranium unusually thin. Medulla oblongata small and extremely firm. Occipital foramen scarcely admitted the little finger, from enlargement of the odontoid process and the thickened ligaments anteriorly. The atlas was anchylosed to the skull. Right middle cervical ganglion unusually large.—*Med.-Chir. Trans.*, vol. xxiv.

CASE XXXVII. 1845.—Man, fifty years. Luxated neck. Pulse much slower than normal. Died in forty-eight hours.—*Medical Gazette*, vol. xvii. p. 901.

CASE XXXVIII. 1848. *Pseudo-apoplexy with permanent slow pulse.* (Dr. J. C. Cain, Physician to Marine Hospital, Charleston, S. C.)—Man, forty-five years. Admitted to hospital July 17, 1848. Three years before, after exposure, uneasiness in region of heart, with fluttering. No fever. Passed off in a few days, but returned on exposure to wet weather. These symptoms continued until three years later, when dyspnœa, palpitation, and exhaustion began, on making any unusual exertion. In July, pseudo-apoplectic [epileptiform?] attacks began, from which he soon recovered. Two weeks later, had another attack, when he came to the hospital. Several seizures occurred at intervals of a few days. Pulse 34, falling to 28 after fit. Heart sounds otherwise normal. Attacks increased in frequency, and November 2d he died, after two fits.

Autopsy.—Mediastinum thickened and strongly adherent to the pericardium. Pericardium enormously distended with a straw-colored liquid—three and a half pints. Whole heart enlarged, left side more than the right. Right side of heart greatly distended with blood, and large quantity of fluid and coagulated blood in both ventricles. Walls of right ventricle thinner than normal. Left ventricle thin at apex. Muscular substance of both softened. Aorta, as far as the arch, corrugated. Brain healthy. Dura mater slightly injected over longitudinal sinus. Moderate engorgement of the meninges. Minute quantity of serum in ventricle of brain.—*Charleston Med. Journ.*, 1849, iv. p. 271.

Dr. Cain expresses the opinion that the "pseudo-apoplectic or syncopic attacks with slow pulse, are due to certain pathological diseases of the brain and heart combined." In Dr. Stokes's cases (*idem*) there was weak heart with aortic murmur on the first sound. In Dr. Adam's cases, four pseudo-apoplectic attacks, fatty degeneration of the heart was found. (*Idem.*) In Dr. Duggan's case there occurred twenty attacks. Ventricles were found in a state of fatty degeneration, and the valves of the aorta were studded with specks of bone. (*Idem.*) In another case there was lesion of the aortic valves, with remarkable softening of the left ventricle. In the case of the Earl of K. (Dr. Law) there was a thickened and ossified condition of the aortic

valves. (*Idem.*) In other cases of permanent slow pulse, fatty degeneration of the heart existed. (Drs. Smith and Carmichael, Dublin.)

Dr. Stokes agreed with Prof. Law in the opinion that the pseudo-apoplectic attacks are due to diminished or feeble circulation through the brain, rather than to congestion. The number of the fits without paralysis or coma, or dilated pupils, or convulsions, precludes congestion of the brain. Cain considers the heart to be the *fons et origo malorum* in these cases of slow pulse. The cause of death is syncope, as proved by its suddenness and the distention of the cavities after death. Death from apoplexy is never sudden.

In contrast to the report of Dr. Cain is

CASE XXXIX., the Earl of K., in which were found extensive softening of the brain, ventricles of the brain distended with fluid, and substance of left hemisphere so softened as to be of almost a creamy consistence.

[NOTE.—The changes in the brain, and perhaps in the heart, may be a sequence to slow pulse from defective nutrition.—D. W. P.]

The most successful treatment: Head low, absolute rest. Stimulants. Nourishing food.

Cases of slow action of the heart in fever.—Dr. Halpin and Dr. Mease, in joint report on epidemic fever of 1847, stated that they met with nine cases in which the heart's action ranged between 40 and 50 beats in the minute, yet all the cases terminated favorably.—*Dublin Med. Journ.*, No. xiii., February, 1849, p. 116.

CASE XL. 1849. (Charles Halpin, M.D.)—Ellen G., aged eighteen.

December 2, 1848. Pulse 96. Skin hot, tongue dry and clean, considerable thirst, no headache. Fever ran its course mildly, and terminated on eleventh day.

14*th*. Relapsed. Pulse 84.

15*th*. Pulse 70. Pulse continued to decline steadily until the 18th, when it was 42.

18*th*. Pulse 42.

19*th*. Pulse 45.

20*th*. Pulse 46.

21*st*. Pulse 44.

22*d*. Pulse 44.

24*th*. Pulse 40.

25*th*. Pulse 40.

26*th*. Pulse 42.

27*th*. Pulse 52.

28*th*, 29*th*, and 30*th*. Pulse 80. Discharged January 6th, pulse 68.—*Dublin Quarterly Journ. Med. Sci.*, vol. vii., 1849, p. 501.

Two cases of slow action of the heart in fever. James Y. Carrithers, Hendricksville, Ala.

CASE XLI. 1853. *Case of intermittent or remittent fever.*—October 1, 1853. Mr. S., aged twenty. Febrile symptoms. Pulse 90. Light chill. Emetic of ipecac, blue pill, quinine.

4th. Pulse 75.

10th. Pulse 94.

12th. Pulse 70.

17th. Pulse 42.

18th. Pulse 40.

20th. Pulse 40.

23d. Pulse 50.

26th. Pulse 84.—*Southern Med. and Surg. Journal*, 1854, N. S., x. p. 462.

CASE XLII. 1854. *Slow action of the heart in fever.*—Mr. A., aged thirty-four. Intermittent or remittent fever.

November 10, 1853. Pulse 86.

22d. Pulse 74.

23d. Pulse 60.

24th. Pulse 52.

25th. Pulse 46.

26th. Pulse 46.

28th. Pulse 84.

29th. Pulse 68.

30th. Pulse 56.

December 2. Pulse 56.

4th. Pulse 60.—*Southern Med. and Surg. Journal*, 1854, N. S., x. p. 462.

CASE XLIII. 1853.—Mr. S., aged fifty-two years. Previous health good. Within three years had three attacks of faintness, and fell unconscious. No headache, paralysis, or other brain symptoms. April, 1852, after running to catch an omnibus had dyspnœa and palpitation, which increased, and was followed by congestion of the lungs and bronchitis. Pulse, which in health had been 60, now became 28 to the minute. For a year he continued with varying attacks and comparatively good health, pulse varying from 28 to 36 per minute. Died suddenly (July 28th) in a fit of dyspnœa, followed by expectoration of mouthfuls of blood. A large tumor appeared in the abdomen some weeks before his death. No autopsy.—*Association Medical Journal*, London, 1853, p. 877.

CASE XLIV. 1861. *Slowness of the pulse without well-marked disease to account for it.* (St. Bartholomew's Hospital. Dr. Farre.)—William C., painter, fifty-eight years old. May 2d, admitted to hospital. Six weeks before had dizziness, pain in head, sinking sensation at stomach, and dyspnœa. Could walk but a short distance without stopping to rest. Remained in hospital six weeks, pulse ranging from 22 to 34 per minute, always regular. Heart normal. Complained of nothing but debility, which soon disappeared under tonic treatment.

The reporter suggests the symptoms pointed to some insidious disease of the brain. Though a painter, he had never been lead-poisoned. The attack, however, may have been due to lead.—*Lancet*, 1861, N. S., vol. ii. p. 158.

Dr. Watson, *Practice of Physic*, vol. i., says that the slowest pulse he ever met with was 25 per minute, in a man sixty-eight years old, with heart disease and dropsy. He subsequently died suddenly.

CASE XLV. 1837.—Dr. Watson also refers to a case reported in Duncan's *Commentaries*, in which the pulse fell to 9. Person aged fifty-four. A fit of unconsciousness, followed by three other similar fits, violent pain in head, convulsions. Pulse ranged from 9 to 24. Lived two or three days after.

Autopsy.—Two ounces of watery fluid found in the ventricles of the brain, and a gelatinous appearance found in some parts of the pia mater.—*Medical Gazette*, London, 1837–8, N. S., vol. xxii. p. 232. Duncan's *Commentaries*, vol. xvii.

CASE XLVI. 1864. *Remarkable slowness of the pulse coming on during convalescence from rheumatic fever, with a murmur at base of heart, considered anæmic.* (Thomas B. Peacock.)—Female servant, twenty-one years. History of rheumatic fever.

8th day. Pulse 60.
12th day. Pulse 42. Low systolic murmur.
15th day. Pulse 36.
19th day. Pulse 36.
22d day. Pulse 68.
33d day. Pulse 64. Systolic murmur still audible.
41st day. Pulse 48. Systolic murmur still audible.
48th day. Pulse 48. Regular. Slight murmur.—*Medical Times and Gazette*, London, 1864, page 56.

Dr. Peacock does not agree with Dr. Mayo that slow pulse may be due to general exhaustion; usually the opposite.

CASE XLVII.—Thomas B. Peacock (*Medical Times and Gazette*, London, 1864, p. 31) had seen several cases of heart disease in which the pulse ranged from 30 to 50 per minute. In one there was found, at autopsy, a circumscribed aneurism of the septum of the ventricles, with great hypertrophy and dilatation of the left ventricle.

Beside these cases:

CASE XLVIII. 1864. *Case of unusual slowness of pulse. Signs of disease of aortic valves, occasional fits of syncope, of an epileptoid character.*—Laborer, fifty-three years of age. Under observation six years. June, 1857. Cramps in legs, which travelled upward toward the heart, with syncope; followed by

attacks of syncope for seven weeks. Recovered and went to work for fifteen months.

Nov. 1858. Similar attacks for three weeks. Sent to St. Thomas's Hospital. Complained of constant sinking, with repeated attacks of syncope, great difficulty of breathing on slightest exertion. Pulse 28 to 30; respiration 20 to 24. Slow pulse due to prolonged rest between the beats. Heart sounds normal. Had rheumatic fever twelve years before. Moderate drinker. Had not smoked of late years.

Was seen as out-patient for the next four years; pulse from 28 to 32, occasionally rose to 40, and, under excitement or active exertion, to 50 or 60. No attacks of syncope during this time, but always feeble and capable of only slight exertion.

August, 1862. A severe attack; fell unconscious; was unable to work for six weeks.

December, 1863. Has been at work for three months. Dyspnœa on exertion. General health good. Pulse 32 to 34. Slight soft murmur with the systole. Diastolic sound flat. Whizzing sound in left ear.

Remarkable slowness of pulse for several years. Occasional apoplectic or syncopal attacks. Sudden death. No autopsy.—*Medical Times and Gazette*, London, 1864, p. 31.

CASE XLIX. 1864.—Man, seventy years. Fair health except slow pulse. Soldier for thirty-eight years. Pulse 25 to 30, in other respects normal. On one occasion an attack which was regarded as apoplectic. On another became faint and fell down unconscious. Pulse several times down to 20, once to 18 per minute. For three years had occasional attacks of syncope. Sounds of heart presented nothing unusual. First sound short and terminated abruptly by the second. Action of heart regular, rather powerful. Pulse at wrist strong. Percussion normal. Respiration normal. No indication of cerebral disease. Was seized suddenly with an attack of syncope and died. No autopsy. (*Idem.*)

In discussion, Mayo thought slow pulse might be due to ossification of the coronary arteries and atrophy, with or without passive dilatation. Peacock could see no reason for this view. The opposite conditions have been found. Stokes and Quain (*Med.-Chir. Trans.*, vol. xxxiii.) speak of slow pulse frequently accompanying fatty degeneration of the heart, and cases are given to substantiate this statement. Dr. Bence Jones (*Pathol. Trans.*, vol. vii., 1855 and 1856), and Dr. Ogle (*ibid.*, vol. viii., 1855 and 1856), relate cases of fibrinous degeneration of heart with slow pulse.

In these cases of degeneration of the heart, however, slow pulse is the exception (Peacock). Quain, in a table of 51 cases of heart degeneration, reports only 8 in which the pulse was slow—other reporters

to the same effect. In two cases of fibrinous degeneration reported by Dr. Ogle, there was slow pulse in one. The pulse in these cases of degeneration is more likely to be weak and irregular. In some of the most remarkable cases there is no evidence of heart disease whatever.

Slow pulse in aortic disease is entirely opposed to Dr. Mayo's theory that slow pulse is due to atrophy. Slow pulse is caused sometimes by or accompanies general depression, exhaustion, and reduction of strength. Two cases are mentioned where the pulse fell to 35.

In convalescence the pulse often drops below the normal, just as the temperature does.

CASE L. (J. Burney Yeo.)—1872. Man, aged forty-five years. Out-patient King's College Hospital. Beating and throbbing in epigastrium, with pain and tenderness. Had had four attacks of rheumatism. Distinct beat found low down in the epigastrium, lower than ordinary epigastric pulsation. Heart apex-beat in its normal position. Pulse regular and full, but very slow—38 per minute. Over heart a very complex bruit was found. First, loud prolonged systolic murmur, and then immediately after two short sounds, so that with each beat of the heart are heard three distinct murmurs—a loud murmur (systolic); then a short, soft murmur (post-systolic); and another short, soft murmur (pre-systolic). A few days later he died suddenly.

Autopsy.—Pericardium adherent uniformly to every portion of the heart's surface. Heart flabby and dilated. Walls thin, especially right ventricle. Right side distended with a clot, and left auricle distended to three or four times its natural size. Mitral orifice diminished in circumference; segments of valve thickened, puckered, and adherent to each other.

Murmurs explained:

1st. Loud systolic murmur—a regurgitant one from the insufficiency of the mitral valve.

2d. The post-systolic murmur, due to the commencement of the flow of blood from the auricle to the ventricle through the contracted and rigid mitral valve. (Dr. G. Johnson, in the discussion, suggested that this murmur might have been aortic regurgitation.)

3d. The third sound coincided with the contraction of the dilated auricle, which slowly and with difficulty gathered force enough to complete its systole.

Why the pulse was slow. "The ventricle had to wait, as it were, on the auricle, and the auricle, owing to its great distention and the thinness of its walls, could only empty itself slowly and with difficulty. In this way the pulse was delayed, and finally death came from inability of the auricle to empty itself."

The epigastric pulsation was due to the adhesion of the pericardium to the diaphragm, causing the diaphragm to move with the motions of the heart.—*Lancet*, 1872, vol. ii. p. 913.

CASE LI. 1872. *Singularly infrequent pulse.* (St. Thomas's Hospital. Dr. Murchison.)—Pale, gray-haired woman of sixty-six years. Arcus senilis. Occasional fits and loss of consciousness. Pulse 26. With care a weaker beat could be felt immediately after strong beat and then a long pause. Heart normal. Improved on good diet, iron, and rest.—*British Medical Journal*, 1872, vol. ii. p. 715.

CASE LII. 1874. *Remarkably slow pulse in a case of indigestion in an aged female.* (M. A. Malherbe.)—Mme. L., aged seventy-eight years. Pulse 18 to 20. Syncope, marked pallor, apathy. Skin covered with cold sweat.—*Journal de Méd. de l'Ouest*, Nantes, 1874, p. 57.

CASE LIII. 1874.—Female, aged sixty-nine years. Suffered from a nervous shock during siege of Paris. Pulse 25. Heart-sounds normal. Respiration 32. Resembled a person under the influence of calabar bean.

Dr. Percy Boulton considered it a case of vaso-motor neurosis, the vitality of the cardiac ganglia being diminished by shock. A hearty meal would raise the pulse five or ten beats.—*British Medical Journal*, 1874, p. 611.

CASE LIV. 1875. (Pugin Thornton.)—Married woman, aged twenty. Suffering from acute syphilitic laryngitis, for which tracheotomy was performed. Pulse at the time 40. A few hours after operation had an epileptic fit, with convulsive movements, lasting an hour. Had had a fit also one week before. Four weeks later, after returning home, had dizziness and noises in the head and again entered the hospital. Pulse 16.

December 29, 1872. Pulse 16, strong.

January, 1 to 4, 1873. Pulse 20.

FIG. 4.

Sphygmogram taken January 4, 1873. Pulse 20.

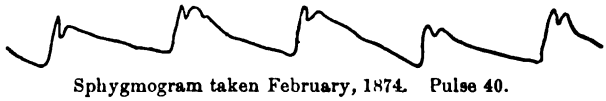
April, 1873. Pulse 40.

FIG. 5.

Sphygmogram taken April, 1873. Pulse 40.

February, 1874. Pulse 40.

FIG. 6.



Sphygmogram taken February, 1874. Pulse 40.

February, 1875. Pulse 48. Canula removed from larynx; grown stout.—*Clin. Soc. Trans.*, London, vol. viii. p. 95.

In this case the slow pulse was undoubtedly due to syphilitic disease of the nerve centres, the exact nature of which could only be known by autopsy.

CASE LV. 1876. *Extreme slowness of pulse in a man aged sixty-six years.* —21 per minute. The year before was operated on for hydrocele, at which time nothing abnormal was noticed about the pulse. Heart-sounds otherwise normal. Slow pulse due to prolonged diastole, which occupied two and a half seconds.—*Gazette des Hôpitaux*, 1876, p. 745.

CASE LVI. *Case of extreme slowness of the pulse in a man otherwise healthy.* —20 pulsations per minute.—(Letter from Dr. Vigouroux.) *Gazette des Hôpitaux*, 1876, p. 788.

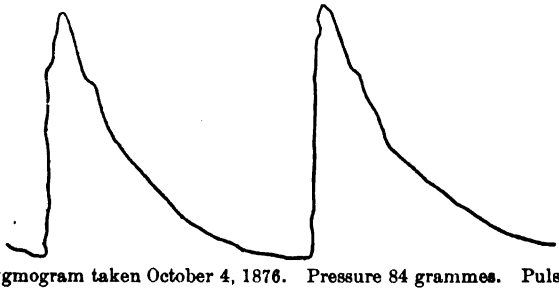
CASE LVII .(E. Trastour.) 1876.—M. X., seventy-four years. Algid pernicious fever. Pulse 10 per minute for several hours, 20 to 25 per minute for six days. Epileptiform crises; pulmonary catarrh. Death by asphyxia on the eleventh day. Pulse rose to 92 before death, which was due to progressive asphyxia.—*Journal de l'Ouest*, Nantes, 1876, p. 11.

[NOTE.—In this case the temperature is not given; but if the diagnosis (fièvre pernicieuse algide) is correct, the cause of the slow pulse was probably collapse from the overwhelming of the nerve-centres by the poison of the disease.—D. W. P.]

CASE LVIII. 1876. *Slow pulse with seizures of epileptoid character.* (C. Handfield Jones.) *Slow pulse. Heart apparently sound, except to dynamic tests. Attacks of total unconsciousness lasting three or four hours. Low temperature. Effect of belladonna on the pulse.*—I. O., shopman, sixty-two years of age. Pulse 33 to 39. Good force. Temperature at 2 P. M., 95.2°.

Oct. 3, 1876. Pulse arrested by pressure of 173 grammes in right wrist.

FIG. 7.



Sphygmogram taken October 4, 1876. Pressure 84 grammes. Pulse 30.

5th. Pulse 28. Temperature 98.4°. Feels better. Had taken iron, spirits of chloroform, and one-half grain of ext. belladonna three times a day.

9th. Medicine stopped and coffee ordered, one pint daily. This gave relief.

From September 30th to October 11th the temperature was subnormal, ranging from 98° to 95.2°. The pulse during same time from 33 to 44. Belladonna was given to lessen inhibitory influence. It had no effect on the pulse, but caused a rise in temperature of 3.2° in three days.

I. O. was readmitted Nov. 24th.

Nov. 24. Pulse 36, temperature 96.8°; unconscious spells.

Dec. 2. Pulse 36, temperature 95.6°; urine normal.

4th. Pulse 38, temperature 96.8°; epileptic attacks at night (petit mal).—*Lancet*, Dec. 30, 1876, p. 919.

CASE LIX. 1876. (Second case reported by Dr. C. Handfield Jones, *Lancet*, Dec. 30, 1876.) *Slow pulse. Attacks of Epilepsy, perhaps also of syncope. Heart-sounds weak. Pulse of fair force.*

Sept. 19, 1876. Pulse very peculiar, 36 per minute; every few seconds a distinct beat, followed by a weak one, and then a long pause. No abnormal heart-sounds.

21st. Pulse 30.

28th. Pulse 28.

Oct. 5. Pulse 28.

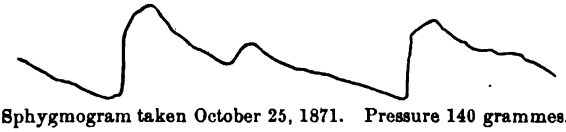
13th. Pulse 23.

16th. Pulse 42. Two days ago had a fit.

23d. Another fit.

Nov. 1. Pulse 33.

FIG. 8.



Sphygmogram taken October 25, 1871. Pressure 140 grammes.

Discussion on Cases LVIII. and LIX.—Dr. Jones thought that both brain and heart were ill-nourished, producing fatty degeneration, and this was a cause of slow pulse; or that the epilepsy caused arrest of the heart by irritation of the *vagus*. Dr. Walshe remarks (3d edit., p. 166) that if slow action is of cerebro-spinal origin, the heart-beat is strong, and if of cardiac origin it is weak. Slow pulse is common in epilepsy. Mr. Thornton considers syphilis a frequent cause of slow pulse. Dr. Jones considered that in his cases the slow pulse was of double origin. The heart was not sound, but had not a decided epileptic tendency existed the peculiar seizures would not have occurred. Bromide of ammonium with iron or phosphorus, or cod-liver oil, would be the best drugs to employ in similar cases.

CASE LX. 1876. (R. Somerville.)—A professional man, aged thirty-seven years; temperate, not a smoker. Good general health. Business worry. Irritation of the stomach. Imprudently ate salt fish for supper; slept badly, and toward morning vomited several times. Tongue clean. Feeling of oppression at the epigastrium. Pulse 25, otherwise normal. 1st day, con-

tinued unchanged. 2d day, pulse much quicker, irregular; heart's action tumultuous; no organic disease. Large doses of brom. potas. and belladonna. 3d day, the same. Pre-cordial oppression less. 8th day, up to date of report of case, improvement continued to recovery.

Peculiar symptoms explained as due to irritation of the pneumogastric nerve from the stomach. Czermak, 1865, is quoted. It is shown that irritation of the pneumogastric slows the heart in man, as it has long been known to do in the lower animals. In Czermak's own person, by pressure on the right side of the neck at the inner side of the sterno-mastoid muscle, squeezing the nerve between the fingers and a small, hard lump, he could reduce his pulse at will one-half, attended with a feeling of oppression and constriction about the sternal region. He divides the nerve into three sections as to its influence on the heart: 1. The roots in the medulla oblongata. 2. The trunk. 3. The terminal branches. 1. Changes in the medulla are the most frequent cause of change in pulse-rate. 2. Trunk is rarely affected. Pressure, as in Czermak's case, or by tumors. 3. The terminal branches are more frequently affected by poisons, as nicotine or lead, which also act on the medulla.

In the case under consideration there was nothing to indicate disease of the medulla, or of the nerve-trunks. The trouble came from affection of the terminal branches through irritation of the stomach. (Or, possibly, there may have been a subtle poison in the salt fish.—D. W. P.)

Meyer and Pribram (*Wien. Akad. Sitzangber.*) found that pinching the stomach would cause slow pulse, irritation being conveyed from the stomach to the medulla oblongata and back to the heart. Supposing it to be reflex, the bromides would be indicated.—*Practitioner* (Lond.), vol. xvi., 1876, p. 186.

CASE LXI. 1879. (John Wheeler.)—Mr. E., carver and gilder. Heavy drinker for some years. Seventy-one years old. First seen twelve months previous, when his pulse was 40, regular and full. Nov. 24. In full possession of all his faculties, and in good spirits; pulse 36, temperature 96°, respiration normal. He is rather lethargic, and spends most of his time in bed.—*British Medical Journal*, vol. ii., 1879, p. 886.

CASE LXII. 1879. (J. Patterson Norris.)—Male, aged sixty-eight years. For past four years, while in the best of health, pulse is only 26 per minute. There is hypertrophy of the heart amounting to "contaurinium." There is occasionally a slight mitral musical murmur, and albumin has been found in his urine on two or three occasions. Is subject to attacks of syncope, and has for months had some swelling about the ankles.

The writer (Dr. Norris) also mentions that he has frequently had pulses varying from 30 to 40 per minute in cases of typhoid fever, when the temperatures were typical of typhoid.—*British Medical Journal*, vol. ii., 1879, p. 886.

CASE LXIII. 1879. (J. Black Noble.)—Male, coal merchant, ninety-six years of age. Suffering from slight bronchial catarrh. Has had seventeen children, the eldest still living at seventy-five years. Pulse on the 24th and 25th, while otherwise normal, was 36 per minute. Intellect clear, sight and hearing good. Syncope threatens if he assumes, for long, the upright position.

The writer would be glad to hear if such a low pulse is rare, as he has never met with a similar case.—*British Medical Journal*, vol. ii., 1879, p. 814.

CASE LXIV. 1879. (Edward Garraway.)—Mr. Noble, in reporting case of slow pulse (36) in a gentleman ninety-six years of age, asks if such is rare.

An old woman here recently passed away at the age of eighty-three years, whose normal pulse when in perfect health some months before her death was 25 per minute.

Mr. Garraway also mentions case of *rapid* pulse in young lady with consumption, 180 per minute, which condition had not varied for months.—*British Medical Journal*, vol. ii., 1879, p. 938.

CASE LXV. 1879. (R. Park.)—Case of parish minister, Ayrshire, whose pulse in 1875 was 32, and on various other occasions only 36. Pulse has always been slow. Both radials alike. The retardation, as far as could be determined, was shared in equally by all the elements of the cardiac revolution. If anything, there was a slight comparative prolongation of the "pause." The sounds were clear, deliberate, and prolonged. When the pulse was counted at 32 there was a condition of general nervous prostration. At other times had ordinary health. The patient was ordinarily vivacious and not by any means of a morose habit.—*British Medical Journal*, vol. ii., 1879, p. 938.

CASE LXVI. 1879. (Jos. Quirke.)—Gentleman, aged thirty-eight years. Constipated habit and torpid liver. Pulse 40, rather weak. Heart sounds somewhat "muffled," but not remarkably so. No valvular disease. No tendency to syncope. No breathlessness on exertion, nor much inconvenience from cold extremities. On subsequent occasions pulse varied from 40 to 60 but when 60 was irregular. A brother was found dead in bed, and some near relatives were of the hemorrhagic diathesis.—*British Medical Journal*, vol. ii., 1879, p. 938.

CASE LXVII. 1879. (James Crocker.)—Gentleman, aged sixty-seven years. Attacks of faintness and indigestion, also symptoms of cerebral softening. Pulse 32, regular, soft, and moderately full. At subsequent visits ranged from 30 to 36, never exceeding the latter. A year later, on three occasions, it was 28. Died suddenly while sitting at the table.—*British Medical Journal*, vol. ii., 1879, p. 938,

CASE LXVIII. 1879.—Woman, aged sixty-nine years. Faintness, dizziness, and general languor. Pulse from 30 to 36. Its usual rate was 32. Is still living and in tolerable health, except occasional faintness.—*Idem.*

CASE LXIX. 1879. (W. A. Wannan.)—May 13, 1879. Mr. ——, seventy-one years of age. Shortness of breath, and unable to go about much. Action of heart very irregular. Pulse weak and slow, 28 per minute. For past six months has ranged from 28 to 30 per minute. Well in every other respect. Cautioned not to leave home much, or stoop much. as in working in garden, to smoke very little, and, as a stimulant, whiskey in moderation.—*British Medical Journal*, vol. ii., 1879, p. 1020.

1879. R. Gossett Brown says: In many thousands of cases, both in hospital and in private practice, I have twice seen cases of slow pulse.

CASE LXX. 1879.—Clergyman, eighty-five years. For six or eight years never knew his pulse to exceed 32. Suffered from concentric hypertrophy. One Sunday had an interview with him. At 3 o'clock the following morning was summoned and found him dead in bed.

CASE LXXI.—Gentleman, aged seventy. Autumn of 1872, was called to see him. To use his own expression, "had never had an ache or a pain in his life." Pulse 110, temp. 102°, slight friction sound. Next day pulse 124, temp. 102°. Three days later, pulse 114, firm and regular. As syncope threatened if he assumed the erect posture, he was kept recumbent. For months the pulse did not exceed 17. Treatment, moderate doses of iodide of ammonium and iodide of iron, with sustenance every hour or two, night and day. At length the pulse reached 19. The medicinal agents employed were adopted under the impression that during the early days some deposit had taken place on the membranous covering of the aorta. At length the pulse rose to 25, then to 30, and at length to 42, at which time he was allowed to take gentle exercise in charge of an attendant, who always goes prepared with stimulants. He is still alive.—*British Medical Journal*, vol. ii., 1879, p. 1020.

CASE LXXII. (George Granville Bantock.)—December 3, 1879. Woman, sixty-five years. Ovariotomy; tumor weighing forty pounds removed. Previous to operation pulse was 46. Took chloroform well, and at end of operation pulse was 36. Temperature did not exceed 99.8°, and is now normal. Heart sounds quite healthy and beat very regular. Patient is a little woman, rather spare, and carries her three score and five years very well.—*British Medical Journal*, vol. ii., 1879, p. 1020.

CASE LXXIII. (W. C. Shaw.)—May, 1887. John Murphy, aged nineteen. In usual health until May 19, 1887, when he began to feel badly. May 21st, after an attack of cholera morbus, he fainted. Pulse 25 to 27. Ammonia to nostrils, head low. Same evening, pulse 21, resp. 36. For two hours pulse remained from 18 to 21. At 11 P. M., pulse 40. May 23d, pulse 45. Recovered.—*Pittsburgh Medical Review*, 1886, p. 245.

CASE LXXIV. (Lebrun.) 1887. *Case of permanent retardation of the pulse, with attacks of syncope and epileptiform seizures.*—Pulse 18 to 36 per minute. Died in epileptiform attack. No autopsy. Quotes Charcot, referring to three cases in which the cause of slow pulse was ascribed to the nerve centres. (Leçons sur les Maladies du Système Nerveaux.)—*Bull. Acad. Royal de Méd.*, 1887, p. 737.

CASE LXXV. 1888. (Dr. Squire.)—Large, fine-looking man, aged eighty years. Pulse ordinarily 28 per minute. Ten years ago had heart trouble, the nature of which was not known. Since that time pulse has ranged between 24 and 32 per minute. The heart is hypertrophied, and the arteries hard. No sign of valvular lesion. No intermediate beat. He is in excellent health, with uncommon vigor for his age, and, except that he is short-breathed when he walks up hill, or makes other exertion, shows no sign of failure of the circulatory apparatus.—*Medical Record*, November 26, 1888.

CASE LXXVI. 1869. *Very slow pulse, connected, probably, with disturbance of the digestive functions.* (Dr. Jackson.)—Farmer, fifty-three years old. For twenty-five years has suffered from costiveness, but general health good. For eight years dyspeptic symptoms. Weak, sometimes giddy, would fall unconscious. Pulse 20 per minute, at one time as low as 12, not unfrequently would rise to 60. Pulse full and strong. No pain around heart. No palpitation. Slight systolic souffle. Heart sounds muffled and distant. Hands and feet cold. Is able to do light work. Is pale when he has his worst attacks.—*Boston Med. and Surg. Journal*, N. S., vol. iii., 1869, p. 376.

CASE LXXVII. 1880. (C. K. Kelly.)—Young man. Exceedingly sick with acute dysentery. Pulse 40, which it never exceeded. Recovered. Several months after, met him returning from work (carpenter) in perfect health, and took his pulse, to find it 40.—*Medical Record* (N. Y.), 1880, vol. xvii. p. 164.

A. T. Keyt, M.D., Cinn., refers to previous observations as demonstrating exaggerated delay of pulse in mitral insufficiency, aortic obstruction from heavy aortic valves, and aortic aneurism.—*Cincinnati Lancet and Clinic*, March 22 and April 19, 1879; *Medical Record*, November 29, 1879.

CASE LXXVIII. 1879.—Chris. H., aged thirty-one. "Enormous delay of the pulse." Systolic murmur accentuated both at apex and second left interspace. Second sound clear and loud. Sphygmograms were taken September 6, 1879, and are reproduced in the report, showing tracing from the heart, the subclavian arteries, and the radials. Patient died November 16, 1879.

Autopsy.—Heart weighed fifteen ounces, and was fatty. Just above the aortic valves were two aneurismal pouches, one projecting forward and to the right, and the other forward and to the left. The first of these, looking like a dilatation of the *sinus of Valsalva*, contained no clots; the other was filled with laminated fibrin. The latter was the size of a small apple and presented a distinct ring about half the diameter of the pouch. It pushed its way in various directions, and pressed upon the pulmonary artery in such a manner as to occlude that vessel entirely. Both dilatations had very thin walls. The aortic valves were very much thickened, but were competent by the hydrostatic test. The mitral valve was filled with nodular vegetations and was incompetent. Right auricle distended with soft clot and fluid. Tricuspid and pulmonary valves presented no disease. Pericardium thickened, and contained twenty-one ounces of fluid. Aorta atheromatous.—*Medical Record*, vol. xvii., 1880, p. 169.

[The enormous delay of pulse referred to in this case, is not a slowing of the pulse, but delay in the time occupied by the pulse wave in reaching the radial artery. This is given as $\frac{49}{100}$th of a second to reach the right subclavian, and $\frac{47}{100}$th of a second to reach the radial. This is considered as enormous, when it is remembered that the normal delay to the subclavian should be $\frac{1}{15}$th of a second.—D. W. P.]

CASE LXXIX. *Pulse down to 3 per minute.*—M. V., aged seventy years. Robust constitution. Pains in limbs and knees. Rheumatism. Attack of

convulsive movements, but not feeling ill. Pulse 24. Pulse previously had been normal. Spasms continued to recur with increasing violence until after ten days they ceased and pulse returned to 70. The pulsations of the heart on March 23d were 24, and continued to diminish in frequency until, for several hours before the change for the better, but 3 pulsations could be distinguished to the minute. At date of report, six weeks later, he was much prostrated, but conversed and ate and seemed improving.

CASE LXXX. 1876. (M. Tillaux.)—Case of old person with pulse of 20 per minute. Attacks of syncope, emphysema of lungs, displacement of apex of the heart, and *bruit de souffle*, which is prolonged during the whole of the systole.—*Gaz. des Hôpitaux*, Paris, 1876, xlix. p. 788.

CASE LXXXI. (C. Barham.)—Lady, sixty-nine years, suddenly expired. Six weeks before had had apoplectic attack from which she was recovering. Her usual pulse was 28 per minute, but on the day of her death had risen to 38, which excited apprehension in the mind of her medical attendant, who saw her a few hours before death. She had had four apoplectic seizures in twelve years, but during the interval had frequent fainting spells. Cupping over the nucha gave relief. Attacks of indigestion aggravated them. She was very sensitive to cold.—*Prov. Med. and Surg. Journal*, Gelm., p. 68.

CASE LXXXII. 1880. (J. S. Gunning.)—Man, fifty-two years of age, a pedler, with pulse of 22 per minute. Change in position did not affect pulse. Heart sounds clear and normal. Never had any serious illness. Saw him in two or three prolonged fainting fits. Continued this way about eighteen months. One morning fell dead from his chair after some slight excitement. He was shown to several medical men, who had never seen so remarkably slow a pulse.—*British Medical Journal*, vol. i., 1880, p. 113.

CASE LXXXIII. 1880. *Pulse as low as 4 per minute.* (W. Henry Day.)—Man, aged seventy-nine. Pulse for nine months has been 22 per minute, full, fairly strong and regular, but accompanied with great precordial uneasiness and tendency to syncope. Attributed his heart troubles to hypodermatic use of morphia. Eighteen months before, suffered a compound fracture of fibula and tibia, for pain from which the morphia had been given. After hypodermatic injection, had a "horrible sensation" at the heart, so that he preferred to endure the neuralgia rather than take it. Later on, began to suffer convulsive fits. One day, while holding the finger on the pulse, he had a fit. The pulse suddenly stopped, and a violent spasm seemed to radiate from the heart to every part of the body, which was convulsed from head to foot, the eyes opening and shutting every second. The heart did not beat for thirty-five seconds, then for twenty-five seconds. It beat *four times per minute for about four minutes*, when consciousness, which ceased when the pulse stopped, returned as the pulse went up to 22. The fits increased in frequency until he died exhausted.—*British Medical Journal*, vol. i., 1880, p. 113.

CASE LXXXIV. 1879. (W. J. Tyson.)—Gentleman, aged seventy-four, fell down, and was insensible for a few minutes. Soon after, pulse was 28. From June 21, 1879, to July 3, 1879, pulse was from 22 to 28. When pulse

became 22, which it did many times a day, he became insensible, and he had a fit resembling epilepsy. In several of these attacks it was thought that he must die. He became convulsed and livid. They usually lasted about one minute, but sometimes as long as three or four minutes. For several days the seizures came every ten minutes. After July 3d they gradually passed off. Pulse 28, full and regular. August 8th, another attack of syncope. From August 8th to August 13th, pulse between 15 and 56. Gradually improved, and now is well, with pulse of 60. Treatment: Kept in bed, stimulants, nitrite of amyl, ammon., digitalis, but could see no effect from the treatment.

It is interesting to note that of eleven cases recorded in the *Journal*, the average age was seventy-two, and that eight were males.—*British Medical Journal*, vol. i., 1880, p. 113.

CASE LXXXV. 1842. (T. B. Peacock.)—Gentleman, aged seventy. In good health up to sixty years of age. Had been thirty-eight years in the army. Six years ago had apoplectic attack, followed by palpitation, uneasiness in region of heart, and a sensation as of something rushing to the top of the head. Pulse quicker than usual and intermittent. Two years later, became suddenly faint on making exertion, and fell down insensible. After recovering consciousness, a feeling of faintness and languor was still felt. Pulse 25 to 30 per minute, which continued for four years; on one occasion down to 18, and after unusual exertion it would sometimes rise to 34. During three years was liable to syncope, but for the last year had been free from them, and in fairly good health. Action of heart regular, pulsation strong. No double beat. No evidence of valvular disease. Respiration easy and natural. No sign of cerebral disease. First saw him in 1838. In 1840, pulse 26. Heart still nearly normal. No valvular disease. Left side somewhat hypertrophied and dilated. Had always been temperate in his habits. He continued in his usual health until seven years after the remarkable slowness of the pulse showed itself, when he died suddenly in an attack of syncope. No autopsy. —*Provincial Medical and Surgical Journal*, London, 1842, p. 68.

Dr. Austin Flint, *American Practitioner*, 1876, vol. xiii. p. 1, refers to the following conditions as a cause of irregular and retarded action of the heart:

Derangements of digestion, anæmia, sexual excesses, the immoderate use of tobacco, and prolonged mental anxiety. To these is to be added an intrinsic tendency of some persons to functional disorder of the organ.

Persistently rapid pulse also is referred to as an accompaniment of certain functional disorders, and also Grave's or Basedow's disease is referred to. [The present writer once saw a case of Basedow's disease in which the pulse was between 200 and 300 constantly several days before death, and another case of irritable bladder in a female, with a pulse of from 140 to 180 for several months, with recovery.—D. W. P.]

CASE LXXXVI. 1876. (A. Flint.)—Female, thirty-five years old. General health good, excepting some neuropathic ailments. Heart normal. Pulse previously of usual frequency. After a choking attack in eating, causing violent and persistent coughing, with a sense of suffocation, she became livid, and

was greatly prostrated; kept her bed for several days, complaining of faintness whenever raised, and suffering from irritability of the stomach. Pulse, 40 per minute. Gradually returned to normal in two or three weeks, and she recovered. Died of typhoid fever several years after, and at autopsy heart was found normal.—*American Practitioner*, vol. xiii., 1876, p. 5.

CASE LXXXVII. 1876. (A. Flint.)—W. H. B., thirty-eight years. Convalescing from an attack of acute pneumonia of right lung. Was taken with sudden sense of great prostration coming on about noon—a feeling as if death were imminent from stoppage of the heart. Was in state of great alarm, cold perspiration, pulse 40, intermittent. No cardiac murmur nor increase of cardiac dulness. For six weeks these attacks recurred. Lowest pulse noted was 35. Urine normal; temp. normal. Made a tedious, but finally complete recovery.—*American Practitioner*, vol. xiii., 1876, p. 6.

CASE LXXXVIII. 1874. (Dr. Foree.)—Mr. B., fifty-three years. Intermittent fever for a year previous. After taking cold, pulse 25 per minute, rhythm, fulness, and force good. Resp. 24. Heart sounds normal. Recumbent posture and stimulants ordered.

1st day, pulse 25, resp. 24, temp. 97°.
2d day, pulse 32, resp. 15.
3d day, pulse 36.
4th day, pulse 42.
5th day, pulse 60.
6th day, pulse 80.—*American Practitioner*, June, 1874, and 1876, xiii. p. 7.

CASE LXXXIX. 1876. (Austin Flint.)—Mr. S., forty-six years. Subject to sick headache; otherwise robust. Seen in consultation with Dr. J. H. Vandy, of Jersey City. May, 1875, attack supposed to be malaria with sick headache. Latter continuous and more severe at night, at times with delirium. Most of the time savagely cross. Pain in head relieved by morphia. Pulse in health 70 to 75 per minute. Ten days after illness commenced pulse was found to be 40 per minute, once 38, increasing toward evening to 46 or 48. In three weeks was out of doors, though having headache for several weeks. Quinine was given throughout the disease. The pulse gradually became more frequent, and finally returned to 74 per minute. —*American Practitioner*, vol. xiii., 1876, p. 8.

CASE XC. 1876. (A. Flint.)—H. G., forty-three years. Seen in consultation with Professors Willard Parker and A. Jacobi. Had a previous illness of a similar character. Fairly good general health. January, 1874, weakness and palpitation on going up stairs. Pulse 40 per minute. No abnormal cardiac sound. Lungs, liver, spleen, and urine show no sign of disease. He remained much the same until the following April, when he had attacks described like a cloud passing over him. These occurred generally in the erect posture, and especially when walking. In April, pulse from 30 to 34 per minute. From May, 1874, to May, 1875, health good. Pulse from 30 to 40 per minute. May, 1875, had epileptiform convulsions. Pulse accelerated during seizures, but in interval from 24 to 36. After May, up

to August, no convulsions, but pulse 26 and irregular. During August three epileptiform seizures, more severe, one lasting fifteen minutes. During seizures he became cyanotic; movements and appearances as though asphyxiated. Pulse during seizure 40. In September, Dr. Knapp examined retinæ and pronounced them normal. Improved, attacks lighter, pulse rose from 26 to 36 per minute, and in November, 1875, was attending to business. Stimulants, bromide of potassium, and electricity were used, but did no good.—*American Practitioner*, vol. xiii., 1876, p. 9.

Dr. Flint's discussion of his five cases: Cases by Dr. Paget Thornton. 6 cases, 4 males, 2 females. Ages, 20, 35, 32, 53, 46, and 43 years. Pulses from 16, 40, 35, 26, 38, 26. Gives cases of Dr. Archibald Hewan. See *Medical Times and Gazette*, London, March 28, 1875.

Dr. Flint speaks of it as a variety of functional disorder.

Napoleon the Great. Pulse 40. Felt uncomfortable if it rose to 60.

Necessity of eliminating double sound, and seeing that heart pulse and radial pulse correspond.

Infrequent pulse in brain injuries and diseases.

Infrequent pulse in jaundice and uræmia.

Infrequent pulse from poisons, aconite, digitalis, V. viride.

Slow pulse, stimulation of pneumogastric nerve.

Quick pulse, paralysis of pneumogastric nerve.

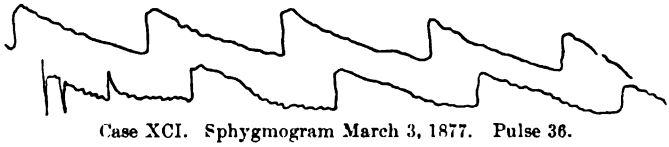
In palpitation, Dr. Farquharson uses the expression, "The unrestrained vaso-motor ganglia, if we may use so unscientific an expression, take the bit between their teeth and bolt."

Two varieties: 1. Functional slow pulse. 2. Organic slow pulse.

Treatment: Stimulants, iron, strych., phos., atropia. No digitalis, aconite, or galvanism.

CASE XCI. 1877. (Dr. James Russell.)—Patient presented embarrassed breathing, and was supposed to have water in the pericardium. Pulse usually

FIG. 9.

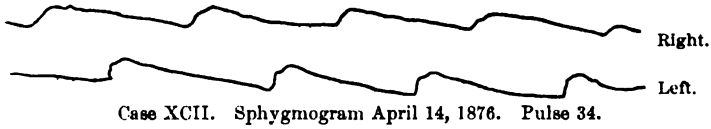


Case XCI. Sphygmogram March 3, 1877. Pulse 36.

29, but on some days was as low as 14. In three months all the heart symptoms disappeared, and pulse regained its normal standard.—*Medical Times and Gazette*, London, 1877, vol. ii. p. 60.

CASE XCII. 1876.—Man, thirty-eight years. Admitted to Birmingham General Hospital April 13, 1876. Slow pulse for seven or eight years, but no suffering in consequence. December, 1875, began to have faint attacks. At first two or three a day, but increased in frequency until there were as many as sixty or seventy a day. The faints were attended with momentary insensibility followed by immediate return of consciousness. In some of the fits the eyes were staring and face flushed; in others, the face is unchanged; the patient appearing as though asleep. The attacks took place whether recumbent or erect, and were preceded by a feeling of numbness. Attacks of pain across the epigastrium, irrespective of food; sometimes relieved by eating. This pain, when occurring under the right ribs, always preluded a faint. At other times, before a fit, he experienced an indescribable feeling at the epigastrium, as though vomiting would relieve him. The pulse during eighteen months varied little from 32. Once it was 19, twice 24, and twice 26. Nine times only did it exceed 34. Once rose to 43. Temperature on admission 98° to 98.4° in axilla. Later, temperature in mouth varied between 97.4°

FIG. 10.



Case XCII. Sphygmogram April 14, 1876. Pulse 34.

and 98°. Fundus oculi normal. Pupils below average size, but freely dilatable under atropine. For the rest, health fairly good, but markedly indisposed to exertion and much wanting in physical and mental energy. All treatment fruitless. Digitalis not only failed, but produced marked uneasiness. Belladonna failed. Bromides likewise. Electricity had no effect.—*Medical Times and Gazette*, vol. ii., 1877, p. 60.

Remarks on unusual slowness of pulse founded on a case illustrating that form of disease. (Dr. James Russell.) Discusses the subject, and gives an analysis of thirty-eight cases noted. The importance of heart disease, especially degeneration of the heart walls, as a cause, is dwelt upon.—*Medical Times and Gazette*, vol. ii., 1877, p. 58.

Dr. Stokes (*Dublin Quarterly Journal*, vol. ii.) refers to "typhoid softening of the heart as coexisting with a pulse of from 30 to 40 per minute." A like degree of slowness has been noticed by other observers, especially by Dr. Murchison, as likely to occur in that form of fever.

"On the whole (says Dr. Russell), the conclusion respecting these cases of degeneration of the tissues of the heart must be that, although the degeneration does not offer of itself a full and complete explanation of the reduced frequency of the pulse met with in certain of the cases, yet it constitutes a very important indication of the presence in the heart itself of some influence directly interfering with the irritability of its fibre; thus these cases have much value, in reference to the others already mentioned in which evidence of other forms of heart disease was presented by the patient."

CASE XCIII. 1877.—Case of Mr. Hodgson, who suffered from cardiac degeneration, had a pulse of 40, and referred the diminution in frequency to overwork. Mr. Crompton, who refers to the above case, also mentioned a patient of his own who had a notably slow pulse for many years without affecting his health. This latter gentleman's son also had a slow pulse.—*Medical Times and Gazette*, 1877, vol. ii. p. 230.

CASE XCIV. 1874.—Dr. Archibald Hewan's own case. Twenty years before had studied greatly; pulse then 72 per minute, afterward was 55, and eight years ago was 24. Had never had a fit nor fainted, and could bear cold well. Had rheumatic fever eight years before, when pulse did not rise above 32. Eight weeks ago had gout and rheumatic pains, when pulse rose to 64 and 68, after which it fell slowly to 32 and 28, where it remains.—*Monthly Abstract of Medical Science*, Philadelphia, 1874–5, p. 400.

The following additional references upon the subject of slow pulse are appended.

The writer regrets that for want of time it has been impossible for him to examine them for incorporation in the present paper, but contents himself with the reflection that it has already reached the limit of endurance to the reader.

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DISCUSSION.

DR. S. WEIR MITCHELL: I should like to refer to one or two points. I do not observe that the number of respirations is stated. It might be desirable to record it in relation with the highest and lowest pulse-rate.

The influence of posture is not noted. This is important in the study of heart-beats. I should also like to know if, with this extremely low temperature, the man complained of feeling cold. I should think that it would also be desirable to have the eye-ground carefully studied.

DR. FRANCIS P. KINNICUTT: I have seen one case resembling Dr. Prentiss's in many particulars. The habitual pulse, perfectly regular, varied between 30 and 40 per minute. The man was in active business and apparently in fairly good health. Occasionally his pulse fell as low as 13 and once to 7 under his (Dr. Kinnicutt's) observation. These attacks were always accompanied with epileptiform seizures. They continued over a period of a number of years without causing any material deterioration in the patient's health. The pulse in the radials corresponded exactly with the contraction of the heart as heard and seen in the cardiac area. There was organic disease of the

heart, but of the ordinary variety of mitral insufficiency, and it seemed to him inadequate to explain the symptoms described.

From the examination of Dr. Prentiss's patient, and from a study of the pulse tracings, he thought it was evident that a condition of endarteritis existed. The temporals and radials were decidedly thickened. The radial could be traced as far as the elbow. A study of the pulse tracings showed a decided increase in arterial tension.

He would ask, in this connection, if any drugs that commonly relieve arterial tension were given at the time of the greatest reduction of the pulse-rate, and if so, with what results?

DR. A. JACOBI: Dr. Prentiss has gone over this subject very fully, but I should like to add a few remarks in regard to etiology. In well diagnosticated fatty degeneration of the heart we generally have a frequent pulse, but in a number of cases of fatty degeneration of the heart the pulse-rate is slow, although not so slow as in the case reported, but down to 60, 50, or 45 per minute. There must, then, be differences in the nature of the fatty degeneration. I believe that we have to look for its exact seat in the heart in order to explain why in one case the pulse should be frequent and in another very slow. I believe that it can be proven that where there is fatty degeneration of the heart muscle, the muscle being weakened thereby, the pulse is, as a rule, accelerated, but when the degeneration is principally located in the sympathetic ganglia, the pulse will be slow. I have seen a few such cases with the pulse coming down to 28, and even to 18, with attacks of syncope, and also, now and then, complicated with epileptic seizures. I have seen this continue for a number of years, until finally the patient died. One case was that of a physician, of New York, who died eight or nine years ago at the age of 53 or 54 years. He had a pulse, regularly, of 26, 27, 28 per minute. Now and then I have seen it as low as 22 and 18. I was never present at his attacks of syncope, when it was reported that the pulse was as low as 13 per minute. His temperature was always below normal; as a rule 97° or 97.5°. He never had a higher temperature.

The patient shown by Dr. Prentiss has a hard pulse, and the artery is evidently in a condition of atheromatous degeneration. The systole is not quite clear, but it is regular. I should add that in all the cases that I have seen, and particularly in that of the physician just mentioned, the heart sounds have been much changed. Instead of two, there have been four or five. The contractions were broken up and interrupted. At the post-mortem examination in this case, there was found atheromatous degeneration of the aorta and of all the large arteries, fatty degeneration of the heart, and a change of the heart ganglia, which were enlarged, hard, and part of them the seat of calcareous degeneration. I was induced to look for these conditions, as the case occurred only a short time after the appearance of this article[1] by Tutjatin, which I hold in my hand. It refers to the changes in the

[1] Archiv. für Path. Anat. und Physiol. Virchow, 1878, vol. lxxiv. p. 461.

sympathetic ganglia. The following is a translation of some of the conclusions:

"In the chronic disorders of the heart and aorta, there were changes in the nerve ganglia in all of the cases examined by us. The inflammatory affections spread to the latter in the contiguity of the tissue.

"In cases of early and rather inconsiderable affection of the heart and aorta, there was hyperæmia and granulating inflammation. In those of long duration, there was in the ganglia an interstitial inflammation with proliferation of solid connective tissue and consecutive alterations in the nerve ganglia. These latter were fatty and in pigment degeneration.

"Finally, there may be sometimes complete degeneration, even to extinction of the ganglionic cells and calcareous infiltration of the interstitial tissue. The changes may be the result of simple inflammation, or depend on constitutional diseases, such as syphilis (in two of my cases there was no syphilis).

"The changes in the nerve ganglia described above, exert their influence on the physiological action of the heart, and it is probable that many functional disorders and even angina may be explained by these changes."

I should like to refer to the fact that a great many people show general or localized atheromatous degeneration at a very early age. Thoma, to whom we owe so much careful research, insists that after the age of thirty-five years atheromatous degeneration begins in every human organism, and thus it is that we find people dying of old age changes at the age of forty-five or fifty. It is not uncommon to see senile apoplexy before the age of fifty years. Old age is only a relative term.

I believe that in the case shown to us by Dr. Prentiss, which will terminate fatally after a while, that there is fatty, atheromatous, and calcareous change of the heart ganglia, which has progressed more than has the general atheromatous degeneration. I believe that this is the explanation of the case. It was so in two of my own cases where post-mortem examinations were made.

Dr. Robert T. Edes: I had the pleasure of seeing the case reported by Dr. Prentiss several times, and was much interested in its diagnosis. One of the first ideas that would naturally suggest itself was organic disease of the heart muscle. I think that in the complete absence of other symptoms, we can leave out of sight organic brain disease. There have been no symptoms whatever of localized cerebral disease, and while there might be a lesion involving the cardiac centres alone, it is highly improbable that it should be so narrowly limited. There were no distinct signs of degeneration of the heart muscle found. Dr. Jacobi has spoken of two sets of cases of fatty degeneration, in one of which the pulse is rapid, and, in the other, slow. In this case the pulse has been persistently slow. There has been nothing like palpitation. Another point is the recovery, or almost recovery, which he experienced. Such fluctuation seems to me to be incompatible with the idea of fatty degeneration.

Another suggestion recently made to me is, that the slow pulse might be

associated with chronic renal degeneration. The urine presents no marked evidences of such condition, but this would not be conclusive. I think that the character of the pulse is against such an hypothesis. He has not the constant tension which you expect in chronic interstitial nephritis. More than that, when we consider how common these cases of nephritis are, it seems to me that if exceedingly slow pulse was one of its symptoms, we should meet with it very often. Although we do have a somewhat slow pulse in nephritis, yet it is not phenomenally slow. It may be as low as 50, but usually 60 to 70 per minute. By this time also we should have a right to expect cardiac hypertrophy, of which there is no evidence.

The only other case which I have had the opportunity of observing in which there was an exceedingly slow pulse, was that of a man some eighty years of age. The pulse at times ran down below 30 per minute, in connection with certain apoplectiform attacks, but rose again when he recovered.

It seems to me that the best hypothesis is either that of a local degeneration of the cardiac ganglia, offered by Dr. Jacobi, or else that of a pure neurosis. I was glad to hear Dr. Jacobi refer to those cases where actual changes were found in these ganglia. I find that our knowledge of the anatomical changes that take place in the cardiac ganglia and plexuses is very limited. There are hardly more than half a dozen references to them. The only systematic author that I know of who lays stress upon this matter is Michel Peter, and he has a good deal to say in regard to inflammatory conditions in the cardiac plexuses and ganglia. He thinks that many cases of inflammation and enlargement of arch of the aorta are accompanied by inflammatory conditions in the plexuses situated upon or below it, and that these changes are at the bottom of some of the heart symptoms.

DR. JACOBI: I do not wish to be misunderstood in regard to fatty degeneration of the heart. I stated that the large majority of these cases have a frequent pulse because the heart muscle is the seat of fatty degeneration, and that in all of the cases where there is a slow pulse, I believed that there would always be found affection of the ganglia. There is no alternation. There is no change. Those cases which have a slow pulse, never have a frequent pulse.

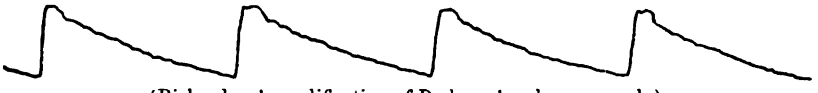
DR. WILLIAM OSLER: I should like to refer to post-febrile slowing of the pulse which is sometimes seen after typhoid fever. I have recently had such a case in which the pulse fell to 32, and on one occasion to 26 per minute. In association also with chronic interstitial myocarditis, although irregularity of the pulse is the rule, an extremely slow pulse does occur under certain circumstances.

DR. I. E. ATKINSON exhibited two sphygmographic tracings illustrating the occasional dependence of abnormally slow pulse, not upon abnormally slow rhythmic cardiac contraction, but upon intermitting, incomplete systole. The patient was a middle-aged laborer, who had sought relief on account of

faintness upon exertion. The radial pulsations varied from 20 to 30 per minute. There was feeble action of the heart with a soft systolic basic murmur (chronic myocarditis).

Fig. 1 shows the usual sphygmographic tracing. Upon auscultating the heart, however, between each full systole could be faintly heard two short

FIG. 1.



(Richardson's modification of Dudgeon's sphygmograph.)

sounds, indicating abortive systolic efforts. These occurred rhythmically. Rarely the wave was propagated to the wrist, as is shown in Fig. 2.

FIG. 2.

DR. G. BAUMGARTEN: In a paper presented last year, I took the opportunity of showing that slow pulse is not so much a diminution in frequency as it is an irregularity in the rhythm of the heart. I have no doubt that most cases of slow pulse originate as a disturbance of rhythm, rather than by inhibition or diminished stimulation—in marked contrast with tachycardia, which is often due to paresis of the inhibitory fibres of the vagus.

THE RELATIONS BETWEEN CHLOROSIS, SIMPLE ANÆMIA, AND PERNICIOUS ANÆMIA, INCLUDING LEUCOCYTHÆMIA AND HODGKIN'S DISEASE.

By FREDERICK P. HENRY, M.D.,
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THE title of the subject which I have the honor to discuss before this Association, viz., the Relations between Anæmia, Chlorosis, Pernicious Anæmia, etc., might be criticised on the ground that it assumes certain relations to exist between these various affections of the blood. To such criticism it might be replied that the selection of such a title is the expression of the universal medical belief that these affections are allied, and that it is in the highest degree improbable that such a practically unanimous verdict can be erroneous.

Without stopping to mention any of the numerous historical instances in which the prevailing medical belief has been erroneous, I will begin by pointing out that in the discussion of this subject everything depends upon what is understood by the term Relation.

While we are justified in speaking of kindred diseases, there are no facts to warrant the belief that one affection can be converted into another, or that the cause of one disease can be so modified by its habitat and general environment as to excite another which is, by common consent, entirely different.

The best example of kinship is afforded by the infectious diseases, which originate, not in the same, but in a similar manner. No nearer relation than this has yet been recognized in disease. In the remotest past there may have been one pathogenic organism, the source of all the ills to which flesh is heir, but at the present time there are many such, and their differentiation is complete and permanent.

There are, therefore, three questions to be discussed:

1. Are chlorosis, simple anæmia, pernicious anæmia, etc., separate diseases?

2. Are they of kindred nature?

3. Are they different stages of one disease?

I will first consider pernicious anæmia, because the determination of its status is of fundamental importance. It is admitted by those who argue most forcibly in favor of the independent nature of this disease that its clinical features are common to a number of affections, particularly cancer and atrophy of gastric glands. They have also been repeatedly associated with the presence of parasites in the intestinal canal, such as anchylostomum duodenale and bothriocephalus latus. In these and other affections the blood has presented the characteristics of pernicious anæmia, viz.: 1. Great diminution of volume. 2. Enormous reduction of the number of the red corpuscles, sometimes to ten per cent. of the normal—*i. e.*, the blood may contain 500,000, instead of 5,000,000, of these bodies to the cubic millimetre. 3. Poikilocytosis—*i. e.*, remarkable alterations in the size and shape of the red corpuscles. 4. Microcytosis, by which is meant the presence in the blood of numerous minute spherical, yellowish-red corpuscles, resembling oil-drops. These are not constantly present. 5, and most diagnostic, a relative richness in hæmoglobin. The percentage of hæmoglobin may equal, exceed, even double, that of the red corpuscles. 6. No absolute increase in the number of the white cells.

By one set of writers it is argued that when, in the course of cancer, atrophy of the stomach, or other disease, the above-mentioned striking changes in the blood are observed, the case is not one of pernicious or idiopathic anæmia, as they term it, because a well-marked lesion is present. If, however, the same alterations of the blood are present, and at the autopsy no lesion can be found except those that are manifestly secondary to the blood-change, such as fatty degeneration of heart and intima of bloodvessels, then the case is one of pernicious or idiopathic anæmia. For example, in 1886,[1] I reported, in conjunction with Professor Osler, a case of atrophy of the secreting structures of the stomach with every clinical feature of pernicious anæmia. About the same time I had under observation another patient, a woman,

[1] American Journal of the Medical Sciences, April, 1886.

whose symptoms and blood-changes were identical with those of the above-mentioned case.

"After an illness of more than a year she died, and at the autopsy, at which I was present, no lesion was found to explain the profound alteration of the blood. According to most authorities, the first of these cases, in which a lesion was found, to which the symptoms might be reasonably attributed, is, for that very reason, not a case of pernicious anæmia. The second case, on the other hand, is one of pernicious or 'idiopathic' anæmia, because a lesion, to which the symptoms might be attributed, was not found."[1]

This kind of reasoning appears to me very unscientific. In both cases there were the same blood-changes, viz., those universally recognized as pathognomonic of pernicious anæmia. In one, the cause of these changes was manifest, or, rather, became so after a careful microscopical examination of the stomach. In the other, it eluded the minutest investigation. The pernicious blood-change was a process common to a known and an unknown cause, and not a separate or independent disease.

An independent disease is one which rests upon a constant anatomical basis, or is invariably produced by the same specific agent. Processes of disease, on the other hand, are common to a number of distinct and independent affections, the most widely distributed of these processes being fever, inflammation, and anæmia. Anæmia may be either a disease or a process—a disease where directly dependent upon a lesion of one of the hæmatopoietic organs; a process when not so dependent. From this point of view, the uniform blood-changes of pernicious anæmia are due to a disturbance of nutrition of the profoundest character, which may arise from a number of causes, some known and others unknown. It is, therefore, nothing more than a disease process, and as such related both to anæmia and chlorosis.

Let us now inquire more particularly as to the mode in which this profound anæmia is produced, whether by a defect of hæmogenesis, an excess of hæmolysis, or by a combination of both.

The causes of anæmia have been divided by Coupland into two classes: "deficiency of income and excess of expenditure," and, according to most writers on diseases of the blood, chlorosis is a typical

[1] Anæmia. By F. P. Henry, M.D. Philadelphia, 1887.

example of the former. In that affection there is a deficient assimilation of iron, which is accounted for in a more or less satisfactory manner by various theories. The most prevalent is that of Bunge, which has been practically adopted by Sir Andrew Clark. Until quite recently, no satisfactory explanation could be given of the efficacy of iron in chlorosis, and especially of the necessity of administering it in large doses, for it was well known that very little of this drug was absorbed. It was also known that our food, which, when in proper amount and variety, contains more iron than we need, does not contain this metal in inorganic form, but in an exceedingly complex organic union. Human milk, which contains the merest trace of iron, supplies all that is needed for the wants of the rapidly growing infant. Nearly all our food-substances contain iron, and there is probably no drinking-water in which traces of it cannot be found. Zander[1] examined the water from three hundred springs, and found iron in every specimen. The same observer examined the feces of chlorotic patients before they had been placed upon any treatment, and found iron in them in considerable quantity—a sure proof that there was no want of this metal in the food. The conclusion, therefore, must be that there is, as already stated, something which interferes with the digestion and assimilation of the superabundant iron contained in the food; and this something is believed by Bunge to be sulphur.

In chlorosis, as is so emphatically insisted upon by Sir Andrew Clark, digestive disturbances are exceedingly common. Abnormal fermentations and decompositions take place in the gastro-intestinal tract, and give rise to the formation of quantities of sulphides which decompose the iron contained in the food, and completely unfit it for the purpose of nutrition. By administering an inorganic preparation of iron we simply offer a bait to these sulphides, which they seize upon and so allow the organic combinations in the food to escape and to be absorbed. This theory explains also why it is often necessary to administer large quantities of iron, for in such cases the sulphides are supposed to be formed in large amount, and to need corresponding quantities of iron to saturate them.

The blood of a healthy adult contains only about forty-five grains of iron (three grammes), and, therefore, in severe cases of chlorosis there

[1] Virchow's Archiv, Bd. 84, 1881.

is only a deficit of about one scruple of this metal. Why then is it so often necessary to administer colossal doses of iron in order to cure a case of chlorosis? Evidently because the iron plays some other *rôle* than that of a food. The theory of Bunge, to which I have just alluded, offers the most satisfactory explanation of its mode of action.[1]

There are other theories of chlorosis supported with equal ingenuity, such as those of Zander[2] and Landwehr,[3] which, in accordance with the division of labor agreed upon between us, I leave to the consideration of the co-referee in this discussion. Suffice it to say that they all unite in referring the cause of chlorosis to a defect in hæmogenesis.

I have entered into these details concerning chlorosis because it is universally conceded to be a typical example of defective hæmogenesis, and because I wish to compare it with another disease—pernicious anæmia, which is now generally attributed to excessive hæmolysis. This opinion, now prevalent, of the nature of pernicious anæmia, is largely due to the elaborate investigations of Dr. William Hunter.[4] This observer not only believes that the blood-changes of pernicious anæmia are essentially hæmolytic, but that "hæmogenesis is so little interfered with that it is generally in excess of the normal." The arguments of Hunter in favor of the independent nature of pernicious anæmia are the most powerful that have yet been advanced. They may be summed up in the concluding paragraph of his valuable paper:

"In pernicious anæmia the seat of disintegration [of the red corpuscles] is chiefly the portal circulation, more especially that portion of it contained within the spleen and the liver, and the destruction is effected by the action of certain poisonous agents, probably of a cadaveric nature, absorbed from the intestinal tract."

Hunter admits that the clinical features of pernicious anæmia are often associated with various gastro-intestinal lesions, especially cancer of the stomach and atrophy of the gastric glands, and with intestinal parasites, but believes such association to be accidental:

"This conclusion is based chiefly on two considerations: (1) that similar anatomical changes, sometimes even more marked, are constantly to be met with in cases presenting none of the features of pernicious anæmia; and

[1] Zeitschrift für physiologische Chemie, 1885.
[2] Loc. cit.
[3] Archiv für die gesammte Physiologie, 1886, Bd. 39, S. 193, and Bd. 40, S. 21.
[4] Lancet, Sept. 22 and 29, Oct. 6, 1888.

(2) that cases of pernicious anæmia are constantly met with in which no such gross anatomical changes are to be found."

Atrophy of gastric glands has often been observed in association with the clinical features of pernicious anæmia, and it is believed by some, myself among the number, to be a cause of that disease-process. The same gastric lesion has existed without the clinical features of pernicious anæmia, and this is one of the reasons why Hunter regards the latter as representing a distinct and independent disease superadded to the former. When closely looked into, this argument loses much, if not all, of its force. The function of the stomach is very complex, and may be largely supplemented by that of the intestine. In fact, in the opinion of some of the best authorities, gastric is merely preparatory to the more perfect intestinal digestion, the office of the stomach being chiefly to coagulate milk and liquefy albuminous bodies. It has been found that a dog whose stomach has been excised may be nourished for an indefinite period by placing food in its duodenum, and there would, I think, be little difficulty in proving that of the various functions of the stomach, the motor is of paramount importance.[1] As I have remarked elsewhere:

"The important part assigned by nature to intestinal digestion, coupled with the fact that it may entirely supplement the action of the stomach, has led Jaworski to attribute a subordinate *rôle* to the stomach, which he regards as a species of warm chamber, in which the food is detained for a time prior to its delivery to the intestine. This view reminds one of the Hippocratic theory of the coction of food by animal heat."[2]

These well-known facts offer one explanation why atrophy of the gastric glands is sometimes associated with the symptoms of pernicious anæmia; at others not so associated. The difference depends upon the preservation or impairment of the motor function of the stomach. The fact that "cases of pernicious anæmia are constantly met with in which no such gross anatomical changes" (as those of cancer and atrophy) "are to be found" affords no proof whatever, as Hunter seems to think it does, of the independent nature of pernicious anæmia. On the contrary, it rather tends to prove that there are two kinds of pernicious anæmia, a structural and a functional.

[1] Vide Klemperer. Ueber die motorische Thätigkeit des Magens: Deutsche medicinische Wochenschrift, Nov. 22, 1888.

[2] American Journal of the Medical Sciences, November 1888, p. 498.

I have just shown that a motor insufficiency of the stomach may be one of the causes of pernicious anæmia. This is generally associated with gross anatomical lesions, such as cancer, atrophy, fibroid thickening, etc. A pernicious anæmia arising under such circumstances may be called structural or organic. There is good reason to believe that a chemical insufficiency of the stomach, long continued, especially if associated with intestinal indigestion, may also give rise to the symptoms of pernicious anæmia. Under these circumstances it would be of the functional variety.

Recent observations have shown that the gastric juice has other functions besides those of curdling milk and liquefying albuminous substances.[1] Although proved by Spallanzani, more than a hundred years ago, to be possessed of antiseptic properties, it is only quite recently that its destructive action upon various microörganisms has been rigorously demonstrated. The facts thus established have an important bearing upon Hunter's theory that the blood corpuscles in pernicious anæmia are destroyed in excessive numbers by a cadaveric poison absorbed from the gastro-intestinal tract. In cancer and atrophy of gastric tubules the gastric juice is notoriously of defective composition, and a deficit of hydrochloric acid has also been observed in certain neuroses of the stomach. With the two first-mentioned conditions the clinical features of pernicious anæmia are often associated, and they have also in a number of instances been clearly of neurotic origin. Several typical cases of pernicious anæmia have been reported by Stephen Mackenzie, of London, R. G. Curtin, of Philadelphia, and others, which had their origin in a profound shock to the nervous system. Probably in all these cases, certainly in the two first-mentioned classes, the antiseptic influence of the gastric juice has been withdrawn from the gastro-intestinal tract and the formation of ptomaines has proceeded therein to an abnormal extent. In this manner the origin of the supposititious cadaveric poison of Hunter may be accounted for.

I will now point to what seems to me another imperfect link in Hunter's chain of reasoning. In his article in the *Practitioner*,[2] in which he discusses, and answers in the affirmative, the question

[1] De l'Action du Suc gastrique sur quelques Microbes pathogènes. Par MM. J. Straus et R. Wurtz. Arch. de Méd. exp. et d'Anat. Path., 1 Mai, 1889.

[2] The Practitioner, August, 1888.

whether pernicious anæmia is a special disease, he acknowledges his adherence to the general opinion that chlorosis is caused by defective hæmogenesis, and attributes this defect to a cadaveric poison which destroys the iron contained in the food we eat. This, as is well known, is the theory of Bunge. Now it seems to me illogical to attribute to one hypothetical ptomaine, that of chlorosis, a power of interfering with hæmogenesis, and to another, that of pernicious anæmia, a power of increasing hæmolysis.

Hæmolysis is increased in pernicious anæmia. This is proved beyond doubt by the able researches of Hunter, but it is, in my opinion, *because of defective hæmogenesis.* The red corpuscles in this affection are abnormally weak and perishable, as is proved by the fact observed by Copeman[1] that their hæmoglobin crystallizes out of them with great readiness. I am not alone in this opinion. In a recent discussion of a case of hæmoglobinuria in the London Medical Society,[2] Dr. Stephen Mackenzie "insisted upon the fact that in essential or pernicious anæmia there appeared to be some defect in the formation of the corpuscles, in addition to their rapid destruction."

I trust I have made it plain that, in my opinion—1. Pernicious anæmia is not an independent disease. 2. It is closely related to chlorosis. 3. It may be the terminal stage of other diseases, and especially of cancer of the stomach and atrophy of the gastric tubules.

The grounds on which I believe pernicious anæmia and chlorosis to be related are not merely theoretical, for I have seen several cases and published one[3] in which a transition between the two affections was, in my opinion, plainly evident, and Trechsel[4] has observed two similar cases. The transition from pernicious anæmia to chlorosis may be observed in any case of the former disease in which marked improvement occurs. Under such circumstances the red corpuscles lose their irregular contours and become circular in outline; they increase in number, and, most important of all, their percentage of hæmoglobin, which may have been equal, or superior, to that of the number of the corpuscles, is now much below the latter. The change is so marked that the case which, seen at its worst stage, would have been unhesitatingly set down as pernicious anæmia, would now, with equal certainty, be regarded as one of chlorosis.

[1] Lancet, May 28, 1887

[2] British Medical Journal, May 4, 1889.

[3] Medical News, July 3, 1886.

[4] Revue médical de la Suisse Romande, June 20, 1888.

The constant presence of fever in pernicious anæmia can no longer be regarded as a point of distinction between that affection and chlorosis, for hyperpyrexia has been frequently observed in the latter, and would, according to Jaccoud,[1] be more often found if looked for. In fact, Trazit[2] devotes his thesis to the consideration of febrile chlorosis.

The origin of pernicious anæmia has been attributed to microörganisms by Frankenhauser,[3] Planchard,[4] and others. The former describes certain minute bodies supposed to be micrococci which he has observed in the blood of several cases of pernicious anæmia. In the liver cells of the same cases he detected threads resembling those of leptothrix buccalis. All of Frankenhauser's patients had carious teeth, and these he believed to be the source of the microörganism of pernicious anæmia.

This theory has found very few adherents, and it is worthy of remark that the latest work on pathological histology,[5] by a countryman of Frankenhauser, makes no mention of it.

In an earlier part of this article I defined an independent disease to be one which rests upon a constant anatomical basis, or is invariably produced by the same specific agent. If this definition is accepted, pernicious anæmia cannot be regarded as an independent disease. Hunter and others have found, in this affection, a constant and decided increase in the amount of iron in the liver, and regard this as its essential anatomical feature. Without any wish to detract from the value of this observation, it seems to me unquestionable that this increase of iron in the liver is a consequence of defective hæmogenesis, and therefore to be classed with fatty degeneration of heart and other secondary changes. It is, in my opinion, plainly evident that the blood corpuscles of pernicious anæmia have undergone a marked degeneration. As I have elsewhere remarked,[6] the facts with reference to the blood of pernicious anæmia are such as to demonstrate a reversion to the type of the cold-blooded animals. This theory might justly be regarded as fanciful, if it were based upon a resemblance of the blood of pernicious anæmia to that of the lower

[1] La Semaine médicale, August 8, 1888.
[2] Journal de Méd. et de Chir., November, 1888.
[3] Centralblatt für die med. Wissensch., 1883, p. 49.
[4] De l'Anémie dite pernicieuse progressive. Thèse de Paris, 1888.
[5] Practicum der pathologischen Histologie, von Dr. Oskar Israel, 1889.
[6] Philadelphia Medical Times, April 3, 1886.

animals, fishes, and reptiles, in any one particular, but the facts show that the corpuscles of pernicious anæmia resemble those of the said animals in their number, their size, their shape, and their percentage of hæmoglobin. In well-marked cases of pernicious anæmia we observe: 1. A reduction of the number of the red corpuscles to a degree that is normal to the cold-blooded animals. It is not at all uncommon, in this disease, to find less than one million red corpuscles per cubic millimetre. Figures such as these are normal in the cold-blooded animals. 2. Many of the corpuscles are much increased in size, so much so that they have received the name of megalocytes. Many of them are quite as large as the corpuscles of the lizard and eel. 3. They often show a tendency to assume an oval outline, as is well seen in the photograph I hand round for your inspection. Accompanying it is a photograph of normal blood, with which it may be compared. The two photographs were taken under precisely similar optical conditions by Mr. W. H. Walmsley, of Philadelphia. The great increase in the size of the diseased corpuscles and their oval shape are very remarkable. The patient from whom the blood was taken was a typical case of pernicious anæmia. 4. To make the resemblance complete, nucleated red corpuscles have often been observed in the blood of pernicious anæmia.

It is a most significant fact, in connection with the relations of the various affections under discussion, that the term "idiopathic" has never been applied to leucocythæmia. This disease was no sooner described by Bennett and Virchow than its association with structural changes in the blood-making organs, especially the spleen, was recognized. It corresponds, therefore, to our definition of an independent disease in being one which rests upon a constant anatomical basis.

The blood-changes of leucocythæmia are so remarkable that they would warrant the separate classification of this disease, even if there were no other constant anatomical lesions associated with it. In the first place, the volume of the blood, which is diminished to such an extraordinary degree in pernicious anæmia, is, in leucocythæmia, not only maintained, but sometimes augmented. In typical cases of this disease there is a condition of plethora, concerning the nature of which there has been some discussion. In the most minutely studied case of leucocythæmia with which I am acquainted—that of Sticker[1]—

[1] Zeitschrift für klinische Medizin, Bd. 14, 1888.

"The increased tension of radial and carotid arteries, the loud aortic-valve sound, and the fulness and tortuousness of retinal arteries and veins, pointed unmistakably to a condition of plethora which Sticker considers hydræmic. On the other hand, von Bamberger,[1] who has often observed dilatation of the heart cavities and abnormal fulness of the vessels in the bodies of those who have died of leukæmia, is doubtful as to the hydræmic nature of this plethora."[2]

He withdrew, by venesection, a small quantity of blood from a leukæmic patient, and analyzed it with the result of proving that its solid residue was greater than that of normal blood. He, therefore, proposes for this condition the term *leukœmic plethora.*

The facies of a leukæmic patient is entirely different from that of a case of pernicious anæmia, and of itself shows that the vessels are well filled with blood. Sticker's patient is described as having a bright color, "*eine lebhaftere Färbung,*" and Delafield[3] reports the case of a man whose lips and skin were of "good color." I, myself, was surprised at the rosy color of the first leukæmic patient whose blood I examined. In addition to this plethoric state of the blood, the increase in the number of the white corpuscles, from which the disease derives its name, the more marked tendency to hemorrhage, and the new formations of lymphadenoid tissue in various parts of the body, all suffice to separate this affection from simple anæmia, chlorosis, and pernicious anæmia.

It remains, therefore, to be considered whether there is any relation between leucocythæmia and Hodgkin's disease. Without pausing to consider the appropriateness of the term, I may say that by Hodgkin's disease we understand an affection of which the most prominent features are an enlargement, more or less general, of the lymphatic glands, enlargement of the spleen chiefly due to hypertrophy of its Malpighian follicles, new formation of adenoid tissue in various parts of the body, and a high, though usually not an extreme, degree of anæmia. From this description it is evident that the lesions of Hodgkin's disease are very similar to, if not identical with, those of lieno-lymphatic leukæmia. In fact, the only material point of distinction between them is the excess of circulating leucocytes in the latter. If, then, we can point to any cases of Hodgkin's disease in

[1] Wiener klin. Wochenschrift, No. 14, 1888.
[2] F. P. Henry, Annual Univ. Med. Sci., vol. iv. 1889.
[3] Philadelphia Medical Times, Feb. 1, 1889.

which the circulating leucocytes, at first normal or subnormal, subsequently increased in number to an inordinate extent, we are justified in regarding them as instances of transition from the one affection to the other, and in assuming a close relation between them.

Fleischer and Penzoldt[1] hold that there are cases of lymphatic pseudoleukæmia which represent the initial stages (*vorstufen*) of a genuine lymphatic leukæmia, and report one in which the transition from the former to the latter was demonstrated. The patient was a male, æt. forty-two, who presented extensive glandular swellings in the neck on both sides and in the left axilla, which slowly enlarged while the condition of the patient became gradually worse. The blood was repeatedly examined, but it was not until about fourteen days before death—*i. e.*, nearly a year after the first blood examination—that the proportion of white cells to red had increased to such an extent (1 : 9) as to warrant the diagnosis of leukæmia.

Mosler[2] reports a case of pseudoleukæmia (Hodgkin's disease) in a boy, fourteen years old, who, when first seen, had enlarged glands in both axillæ, both supra-clavicular regions, and in the cervical and infra-maxillary regions. Neither spleen nor liver was enlarged at first, and there was no increase in the number of the white corpuscles. There was moderate fever. The disease, under treatment by arsenical injections into the glands, came to a standstill for sixteen days, the examination of the blood still giving a negative result, so far as concerns the number of the white cells. The patient then returned home. Eight days later, severe fever set in; the existing glandular tumors enlarged and new ones made their appearance. It also became evident, on physical examination, that the spleen and liver were decidedly enlarged. On microscopic examination, the white corpuscles were now found to be increased in number to such an extent that Mosler estimated them to be equal to the red. The case ran the usual fatal course of leukæmia, but was unusually acute, its whole duration being less than two months. Mosler concludes that too sharp a distinction has been hitherto made between so-called pseudoleukæmia and leukæmia, notwithstanding the fact that this is the first case, in his large experience, in which he had observed a transition from the former to the latter affection.

[1] Deutsche Archiv für klinische Medizin, Bd. 26, 1880, S. 368.
[2] Virchow's Archiv, Bd. 114, 1888, S. 461.

The rarity of such observations as the above is undoubtedly great, but, according to Fleischer and Penzoldt, may be explained in three ways: 1. The transition is overlooked because the blood is not examined with sufficient frequency. 2. A certain time must elapse before the transition is accomplished, and death generally occurs during the pseudoleukæmic stage. For example, in Fleischer and Penzoldt's case the stage of leukæmia was not reached until eight months after the first examination of the blood, and, therefore, if death had occurred from any accident or complication within that period, the case would have been reported as one of pseudoleukæmia. 3. There may be cases of multiple lymphatic tumors which have no relation whatever to leukæmia, but belong to an entirely different species.

As a rule, there is no absolute increase in the number of circulating leucocytes in Hodgkin's disease, and, as just stated, instances of transition from this affection to leukæmia are rarely observed, but cases are not so uncommon in which the number of the white cells, while greater than under normal circumstances, are scarcely numerous enough to warrant the diagnosis of leucocythæmia. Laache[1] reports such a case—one in which the blood was repeatedly examined—the proportion of white to red corpuscles varying between 1 : 70, the highest point, and 1 : 339, the lowest.

I am inclined to regard an excess of white cells in the blood as the expression of a form of defective hæmogenesis which may be the terminal stage of any profound anæmia. In Fleischer and Penzoldt's case, leucocythæmia did not set in until fourteen days before death. In a case of pernicious anæmia reported by Litten,[2] the blood, previously without an excess of white cells, was found to be leukæmic (1 : 15) four days before death, and this condition continued to increase until the day before death, when the proportion of white cells to red was as one to four. In a case reported as pernicious anæmia by J. H. Musser,[3] the term leucocythæmia would, at one stage, have been more appropriate, for the white cells were to the red about as one to four. I recently examined the blood of a profoundly anæmic patient at the time of her admission to the Philadelphia Hospital—two days before her death—and found such an enormous increase in the leucocytes that, at the autopsy, which revealed a large perinephritic

[1] Die Anämie, p 273. [2] Berliner klinische Wochenschrift, Nos. 19 and 20, 1877.
[3] Proceedings Philadelphia County Medical Society, 1885.

abscess, I made a careful, though fruitless, search for some communication between the abscess and a venous trunk. The woman had been in the hospital a short time before, in another ward, and had been regarded as a case of pernicious anæmia. The leucocythæmia was undoubtedly a late manifestation of her cachectic condition.

The foregoing facts lead me to accept the first and fourth conclusions of a paper on the "Relations of Leucocythæmia and Pseudoleukæmia," published many years ago by H. C. Wood :[1]

"1. Clinically, the so-called true and false leukæmia are the same, save only in the matter of the white blood-corpuscles. . . . 4. There are cases which, at one period of their course, represent pseudoleukæmia; at another, leukæmia."

I am also inclined to agree with the opinion of Pepper,[2] in so far as it applies to leucocythæmia and Hodgkin's disease, that

"a condition so inconstant and irregular as the increase in the proportion of white corpuscles should not be made a ground of distinction between groups of cases identical in all other respects."

In this paper I have endeavored to confine myself strictly to the question of the relations of these various forms of anæmia, avoiding, as far as possible, any discussion of their nature. All the time at my disposal would have been occupied in the attempt to enumerate and criticise the different views concerning the pathogeny of leucocythæmia alone.

I have tried to impart and illustrate my belief that the circumstances under which chlorosis and pernicious anæmia arise are so numerous and diverse as to forbid our regarding them as independent diseases. They are, in my opinion, neither more nor less than closely related processes of defective hæmogenesis.

Leucocythæmia and Hodgkin's disease, in that they are always associated with lesions of the blood-making organs—spleen, lymph-glands, bone-marrow, etc.—are independent diseases, or, rather, different stages of the same disease, for such cases as those of Fleischer and Penzoldt, and Mosler, prove their relations to be of the most intimate nature. They also show the fallacy of the view that the local glandular affections of leukæmia are secondary to the accumulation of leucocytes in the blood.

[1] American Journal of the Medical Sciences, October, 1871.
[2] Ibid., October, 1875.

THE RELATIONS OF ANÆMIA TO CHLOROSIS.

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In order to bring the whole subject up for discussion, as proposed by the Council of the Association, the referee and co-referee have thought it judicious to divide it into two sections. This has seemed the more proper as, upon mature consideration, compression of the more or less vague data into the allotted space and time seems almost impossible. To those who have occupied themselves with the pathology of the blood—and there are several in our midst whose names occupy a high position in this respect—the fact is apparent that confusion reigns supreme in this field which might, possibly, be easily cleared away if exact methods of examination were employed. Under all circumstances, our lines might be more strictly drawn and a beginning made for the more accurate and scientific study of these subjects; in this way elimination of one disease from another, or identification, would follow, and much benefit would accrue.

In the discussion of our present subject, the first thing that comes up to confuse us is the definition of the two diseases. Immermann (Ziemssen's *Hdbch.*, xiii. p. 275) begins his definition as follows: "The conception of anæmia, somewhat indefinite in its elasticity, etc.," and follows it up with nearly two pages of text from which the final conclusion is to be drawn that, partly from clinical and partly from direct (analytical) evidence, we are justified in stating that anæmia is that condition in which there is a diminution of red corpuscles as well as of the albumins of the plasma in the blood (hypalbuminosis). Strümpell (*A Text-book of Medicine*, edited by Frederick C. Shattuck, A.M., M.D., p. 874), states that "the essential element in anæmia is, therefore, a diminution in the number of red corpuscles, or

so-called oligocythæmia, and states further on that "oligocythæmia is not invariably accompanied by a diminution in the amount of serum albumin (by which he means plasma—hypalbuminosis)."

If we go on we shall find that anæmia or oligæmia vera really means a diminution of the whole quantity of the blood, and that this condition can be subdivided into hydræmia, oligocythæmia, oligæmia sicca and oligæmia hypalbuminosa. We have then three representative definitions: the one broad and general, including a diminution of any one or all the constituents of the blood; a second, in which hypalbuminosis and oligocythæmia are the principal, if not the only factors; and a third, which makes oligocythæmia alone the characteristic feature. It seems to me that, from a purely practical standpoint, the latter is the best; we are not in a position to determine the whole quantity of blood in a living animal, nor, for more reasons than one, can we make a chemical analysis of blood in any individual case. But we can readily determine the number of red corpuscles in any patient, and, if it be admitted that hypalbuminosis and oligocythæmia go together in the great majority of cases, it will become unnecessary to make a chemical examination of the blood.

A search amongst the authorities for a definition of chlorosis puts us in a much sadder plight than did anæmia. One type of writers is, perhaps, best represented by Coupland in his excellent course of Goulstonian Lectures (*Lancet*, 1881), who says, "I believe chlorosis to be a form of anæmia depending upon similar changes, and, therefore, to be considered as falling under the head of idiopathic anæmia." It is but just to add that this author defines anæmia as that condition in which the essential feature is reduction of the hæmoglobin. Zender (Virchow's *Archiv*, 1881) conceives chlorosis to consist in defective formation of red blood-corpuscles, both quantitatively as well as qualitatively, and adds, further on, that, as iron is diminished in the blood and not excreted, the fault must lie in defective absorption. Then we have authors like Strümpell (loc. cit.) who, defining anæmia as oligocythæmia, state that chlorosis is a term applied to the mild forms of essential anæmia, such as are most often seen in females at the time of puberty. Immermann makes the disease dependent upon a diminution of hæmoglobin, but is not willing to commit himself by stating whether this is absolute for a single red corpuscle or for the whole quantity of blood.

We now come to what seems to me to be the turning-point, in the finding of a sharp, distinctive definition which is to be found in Duncan (*Sitzungsberichte d. Acad. d. Wissenschaften*, Wien, 1867). As far as I know, he is the first to make the distinctive feature oligochromæmia characteristic for chlorosis—that is, in chlorosis we find the individual red corpuscle deficient in hæmoglobin. It will be readily seen that a deficiency in hæmoglobin would exist in any condition in which the number of red corpuscles is diminished; this would be called anæmia according to the definition we have accepted. But the red corpuscles being normal as to quantity and the hæmoglobin diminished, we would be justified in concluding that each individual red corpuscle carries too little hæmoglobin, and this condition would be called chlorosis.

Unfortunately for this definition, the term chlorosis is to be looked upon as an essentially clinical one; it is not going too far to state, I think, that by far the great majority of reported cases of chlorosis are not chlorosis at all. In Germany every other girl is called *bleichsüchtig* (chlorotic), the diagnosis being made by the people and then verified by the physicians; with us chlorosis is a comparatively rare affection, and yet no one doubts for a moment that there are just as many if not more anæmic girls in this country than in Germany. In Russia almost all women are said to be chlorotic, especially in the cities; even the lower strata of society are convinced that they have chlorosis. Five or six years ago a great tide of emigration swept from that country to ours; I had occasion to examine a great many of these women and every case was one of anæmia and not of chlorosis. Within the last year I have seen an American girl who had been compelled to stay in St. Petersburg for several years; she was pronounced chlorotic there by an eminent physician; examination of her blood revealed oligocythæmia (about 70 per cent.) and a proportionate oligochromæmia. This girl was very anæmic, but, according to the conception which we would ask to be accepted, she was not chlorotic.

Another difficulty in the drawing of strict lines consists in the fact that both oligocythæmia and oligochromæmia may occur in the same individual, so that the term chloranæmia is one that is justified by observation of existing conditions. It is more than probable that anæmia is a forerunner of chlorosis in a great many instances, and,

possibly, a very great number of cases occur in which there is a combination of both conditions.

As far as the causes for both conditions are concerned, it will be seen that almost every one put down for anæmia will hold good for chlorosis. Without entering into detail upon this division of the subject, it can be stated that sex, age, a peculiar composition of the blood, and certain vascular anomalies first pointed out by Virchow in 1870, are held to be especially characteristic for chlorosis. If we analyze each one of these causes, it will be seen that the two latter are the only ones to be found in chlorosis. While there can be no possible doubt that chlorosis is a disease of females at puberty, yet cases have been described in which chlorosis has been found in males, and a great many cases are upon record in which the disease has developed either earlier or later than puberty (as late as fifty-seven years, Cantrel). Here, again, the "elasticity" of the term chlorosis must be taken into consideration. In regard to chlorosis in males, if we read the report of the case given by Immermann (p. 532, loc. cit.) it will be seen that this author has given us no positive proof at all that his case is not one of anæmia, although he warns against the too ready acceptance of cases of anæmia as chlorosis. The fact that this case was relieved by energetic chalybeate treatment is apparently looked upon by the author as convincing evidence that it was one of chlorosis. In cases of so-called school-anæmia we are accustomed to expect good results from removal from school and the administration of iron.

As to the age of patients, the process of sexual development has always been looked to as the time of most common occurrence of chlorosis; in anæmia this age also produces a great number of cases, but children and old people are subject to anæmia and, practically, excluded from chlorosis. For the explanation of this fact it became necessary to conceive of the existence of some physical anomaly in the sexual organs: lack of development, malformation, etc. The clinical fact that in some cases we find amenorrhœa, in some, comparatively normal menstruation, and in others menorrhagia, ought to have been sufficient testimony to show that there was no constant genital factor, and, in some cases, none at all. Investigations upon the post-mortem table have verified these statements, and we, therefore, find the genitals well and normally developed in some cases, in others too great a development, and in others a deficiency. These

changes are so varied as to the external genitals, the uterus, and the ovaries, that no causative relation can be established between these lesions and the disease. It is more than probable that the relation is that of effect to cause and not of cause to effect; in other words, that the lesions in the genital organs are due to chlorosis (or anæmia).

It will be seen by examining statistics that by far the greatest number of cases occur between the ages of fifteen and twenty-five—*i. e.*, decidedly after the time of the age of first menstruation, which is supposed to occur between the ages of twelve and fifteen years. Furthermore, the observation that an anæmic constitution is a very strong predisposing cause for chlorosis, has been made by almost every author; some authors, in their description, make cases of anæmia more intense and then call the condition chlorosis. It seems justifiable to conclude that a great many cases of chlorosis have their inception in ordinary cases of anæmia. The continued effort of menstruation and, possibly, the unaccustomed loss of blood going on for a period of time extending over from three to ten years in an anæmic patient having the peculiar metabolism of anæmia, seems to be sufficient to establish the condition we consider characteristic for chlorosis. Again, the fact must not be lost sight of that a comparatively slight cause may set up the condition of chlorosis in a female who has always been considered perfectly healthy. Yet, occurrences like these must be looked upon as exceptions.

The clinical characteristic of chlorosis lies in the peculiar changes in the blood, changes which have been denied by some authors, and the strict meaning of which have been accepted by few. In anæmia we have the red corpuscles as well as the albumins of the plasma reduced in quantity; frequently there is a change in size, shape, and quality of the corpuscles (Osler, Cartwright Lectures, 1886). The change in size of the red corpuscle is in the direction of production of a greater number of smaller corpuscles (microcytes). As a result of the reduction in the number of red corpuscles the Hb. is correspondingly reduced in quantity. In pure chlorosis the number of red corpuscles is not diminished at all, or so slightly that the diminution may be ascribed to the method of enumeration. On the other hand, the tendency to the production of red corpuscles of larger diameter than normal (megalocytes) is especially well marked in chlorosis. While we do not fail to find an appreciable number of micro-

cytes, the large number of megalocytes found is apparent upon very superficial observation. Malassez gives the average size of the red corpuscle in chlorosis as 8.29 μ (7.60 being normal), and the relative size as 1.09 μ (1.0 being normal). These changes, although present to a greater or less extent in every case of chlorosis, are by no means sufficiently characteristic to establish a diagnosis or to enable us to exclude other forms of alterations in the blood. The red corpuscle in chlorotic blood seems decidedly pale to one who has had the color of the individual corpuscle firmly impressed upon his mind. When we deal with large quantities of blood this is apparent to the untrained without any further remark, but the change under the microscope is just as appreciable when the comparison is made with healthy blood. When the blood is examined with the spectroscope or the hæmoglobinometer, the reason for this paleness is readily explained; we find a great diminution in Hb. But this is found in any form of anæmia, so that it becomes necessary to establish the amount of Hb. in each individual corpuscle. In order to do this we must employ the fraction first suggested by Gowers, in which the numerator is the percentage of Hb., and the denominator the percentage of corpuscles. It is not necessary, before this Association, to point out the possibilities of errors in this computation. Gowers says of his instrument that it "is only expected to yield approximate results, accurate within two or three per cent." The more recent instruments are more accurate, possibly, but nevertheless errors are unavoidable.

It seems to me that one great source of error which has been overlooked in all these computations is the neglect of taking the average size of the red corpuscle into consideration. It is true that this is comparatively small when compared with an error of three per cent., yet it would be appreciable when we are dealing with a sample of blood in which the average size of the red corpuscle is very much increased. In order to correct this, the following computation could be made, A representing the average size of the red corpuscle of the examined blood, and B Gowers's fraction:

$$A : 7.50 :: B : x, \quad \text{where } x = \frac{7.50 \times B}{A}.$$

Thus, if we take a sample of blood, in which, by Gowers's equation, the quantity of Hb. in an individual corpuscle is estimated at

$\frac{30}{60}$, and correct by the above formula, using Malassez's figure (8.29 μ), it will be found that the individual corpuscle contains only $\frac{27}{60}$ of Hb., certainly a decided difference. At the end, however, the point to be made in the establishment of the diagnosis of chlorosis is that the single red corpuscle contains less Hb. than normal. It must be added that the amount must be greatly reduced, because of the fact that our methods of computation are not such as could be called mathematically precise, though sufficiently so for clinical purposes.

The difference in the quantity of albumins may be considered another distinctive feature between anæmia and chlorosis. It is said that in anæmia we always have hypalbuminosis, while in chlorosis this is absent. It must be confessed that the statements of authors are so contradictory upon this question, that a definite conclusion cannot be arrived at. It is necessary that this part of the subject be reinvestigated and then, possibly, a positive result will follow. The statement that chlorosis is a cytogenic affection and anæmia both a cytogenic as well as a general affection of the blood is one that, as yet, cannot be considered proven.

One respect in which chlorosis is said to differ materially, if not absolutely, from anæmia consists in the pathological changes first described by Virchow. These changes can be briefly characterized as hypoplasia of the vascular apparatus—narrowing of the lumen of the aorta and larger arteries, as well as thinning of their walls. The heart itself is sometimes found small, at other times hypertrophied. According to this view, every case of chlorosis is congenital and must be due to some faulty development of the mesoblast; it would permit us to state that chlorosis is always congenital, in some cases latent for years, while anæmia, in most cases, is acquired.

A great many objections have been raised against this view; they cannot "be considered as underlying every case of chlorosis or, at any rate, existing as a cause of the anæmia;" "no proof has been given that the diminution in size of the vessel has not followed upon diminution in the total quantity of blood" (Coupland, *loc. cit.*). The first of Coupland's objections certainly holds good; hypoplasia occurs in a great many males, in a far greater number than will be admitted by even the most enthusiastic defenders of male chlorosis, and, in

proportion to the number of females attacked, it is found in a very small number of post-mortem examinations. The second objection—*i. e.*, that we may be dealing with an effect and not a cause—is one that is not easily proven; if it is an effect, it can certainly not be due to a "diminution of the total quantity of blood," for, when this does occur in chlorosis, it is not as great as it is in anæmia, and, probably, with this hypoplasia there frequently occurs a plethora. However this may be, to the best of my knowledge no author has been found who is willing to state that this condition of the bloodvessels is found in any other disease than chlorosis. Even if we are not disposed to look upon these changes as a direct cause, we must certainly be prepared to consider them as predisposing to chlorosis on account of the frequent coincidences of the two.

The relation of the symptoms of anæmia to chlorosis depends upon the conditions of the blood and the anatomical substrata. Given a case of anæmia in which there is only a reduction of Hb. as a result of oligocythæmia, and a case of chlorosis in which there is a reduction of Hb. as a result of oligochromæmia, and metabolism in both of these cases will be approximately the same. It is true that the patient with chlorosis will have a different facies; as the essence of the affection lies in oligochromæmia, the amount of reduction in Hb., if due to oligocythæmia simply, would be so great as to become a physical impossibility, inconsistent with life. But if, in anæmia, we have oligocythæmia as well as hypalbuminosis, which is said to be coexistent in the majority of cases, the metabolism must be different from that of a pure case of oligochromæmia. As a result of reduction in Hb. we have simply a reduction in the process of oxidation in the body; at the same time the waste products are carried off and sufficient albuminous food is carried to the tissues by the plasma of the blood which is unchanged. In this way the general nutrition of the body is apparently not interfered with. Indeed, there may be, and there frequently is, an increased deposit of material in chlorosis, because oxidation is not sufficient to utilize the albumins of the plasma; the result of this process of suboxidation is a deposit of fat, all of which Immermann calls the "nucleus" of the clinical differences between anæmia and chlorosis.

Hypalbuminosis and oligocythæmia produce an entirely different result; as before, we have the same factor, suboxidation, but we have,

in addition, a deficiency in supply. Furthermore, those functions of the plasma otherwise than nutritive are seriously interfered with. Its physical conditions are changed, it does not serve the processes of secretion and excretion as it should, and, being full of excrementitious material, the result is the retention of these substances, the production of fever, etc. In mild cases of anæmia there is produced a loss in weight, in severe cases there is produced that condition which we call marasmus. In chlorosis very little, if any, loss of weight occurs; very frequently the opposite is brought about by a too great supply, and especially by the presence of too much CO_2 preventing the decomposition of the fats. But when anæmia is associated with chlorosis we have a very unfortunate combination, especially where there is a great amount of hypalbuminosis. These are the cases in which the development of pernicious anæmia as a direct consequence of chlorosis can be readily explained. The chlorosis produces oligocythæmia and hypalbuminosis as a result of deficient external food-supply; these two produce the metabolic combination stated above; and, finally, we have established a *circulus vitiosus* into which it seems impossible to break. But these combinations must certainly be looked upon as of extreme rarity.

Unless we believe Virchow's anatomical lesions to belong only to chlorosis, there exists no difference between the symptoms of the two diseases. When these are present they manifest themselves by the ordinary objective signs of whatever change there may be in the heart. We have a normal heart, one that is too small, or one that is larger than normal. The most interesting change that we find is the dilatation of the left ventricle. Considering the hæmic bruits that occur in the heart, it sometimes becomes quite difficult to state whether or not we are dealing with a valvular lesion. This dilatation of the left ventricle may be transitory in its nature, depending, as it does, for its existence upon the quantity of blood to be pumped through the narrowed arteries.

Reference must also be made to symptoms on the part of the nervous system; these have been made one of the characteristics for chlorosis. Hysteria and hysterical conditions are of such common occurrence nowadays, that it seems impossible to make any one condition responsible for them. A careful analysis of female anæmic cases would, I think, demonstrate the fact that just as many of these

are hysterical as in the same number of chlorotics. Before making a careful examination of the blood, it would be very risky to make the diagnosis of oligochromæmia in a patient who is both anæmic and hysterical.

Lastly, we have to consider the therapeutic relations of both diseases. While the reasoning of *ex juvantibus* is certainly justifiable under certain circumstances, it seems to me to be strained in its application by Immermann. He speaks of specific medication, and says that the ease with which iron controls the symptoms of chlorosis is "characteristic" for the latter disease—as "a fortunate relation, which is not found, to the same extent, in any other form of anæmic process, and which, therefore, deserves to be considered as one of the essential peculiarities of the trouble." The degree of success and the time in which it follows the use of chalybeates are to be distinctive for chlorosis as opposed to all other anæmic processes. From a scientific standpoint, this certainly seems a very weak argument to offer, and one that depends, for its verification, upon the individual employing it. To what extent must improvement follow, and in what time, before one case can be called chlorosis and another anæmia? The fact must not be lost sight of, that a great many cases of anæmia are just as much improved by iron as are cases of chlorosis. Although the indiscriminate use of iron in anæmia must be deprecated, yet, upon the whole, iron is just as much looked upon as a specific in anæmia as in chlorosis. As we are led to expect from the essential symptoms of chlorosis, iron would be indicated in every case, and very few authors will be found who do not confirm this therapeutic indication. While, then, we would not be willing to separate anæmia from chlorosis, we are justified in the statement that iron ought to be given in every case of chlorosis, on account of the rapidity and intensity of the chalybeate effect.

Whereas, in anæmia, we try to remove the cause and institute causal treatment, in chlorosis we are satisfied with removing that symptom which is the essential of the disease, either on account of the fact that we are ignorant of the first cause, or on account of our inability to remove it. It has been repeatedly demonstrated that this can be done, and, furthermore, that the removal of this essential symptom is followed temporarily by complete recovery. Whereas, in anæmia, treatment is followed by complete recovery or complete failure, iron, in chlorosis,

will always result in amelioration, even if we cannot remove the tendency to relapses. There are very few cases of chlorosis, even those with the lesions of Virchow, that are not benefited by the administration of iron in sufficient quantity. In a great many cases of anæmia the use of iron would be followed either by negative or by bad results.

DISCUSSION.

DR. WILLIAM OSLER: I am sorry to have to take issue with my friend Dr. Henry on the question of chlorosis. I should regard it as a disease quite distinct from pernicious anæmia. In the first place, on account of the sex affected. For fifteen or sixteen years I have been very constantly engaged in blood work. I have seen a large number of cases of anæmia and of chlorosis, and I have yet to see a case of chlorosis in the male—a distinct, well-marked case. In the second place, the pathological condition, which was first described by Virchow, of hypoplasia of the heart and great vessels is, I believe, a specific anatomical distinction in a certain number of cases. In the third place, the remarkable diminution in the percentage of hæmoglobin is so distinctive, that I have always taught that by attention to this point the diagnosis could be readily made between chlorosis and ordinary anæmia. And fourthly, the ready curability; though relapses are common, we can always cure chlorosis. I do not remember ever to have failed in a case of chlorosis with satisfactory doses of iron, nor do I know of anything more interesting in therapeutics, or more suggestive to students, than to place diagrammatically on the board the relation of hæmoglobin to corpusces at various stages, beginning, for instance, with a percentage of corpuscles of eighty, and a percentage of hæmoglobin of fifteen, and then week by week show the gradual ascent of the percentage of hæmoglobin until at last it reaches the line indicating the percentage of corpuscles.

Until we have more conclusive evidence than exists at present, I shall continue to regard chlorosis as one of the essential anæmias distinct and different from pernicious anæmia in its course and in its anatomical characters.

In regard to progressive pernicious anæmia, we have not yet all the facts which will enable us to determine whether it is an entity or only an associated condition, with atrophy of the stomach, carcinoma, parasites, etc. I have been much impressed with the observations of Hunter, who has corroborated the work of Quincke showing that hæmolysis plays such an important part. If the work done in the next few years is of the same character as that done in the past ten years, we shall soon have the needful data on which to base an opinion whether pernicious anæmia is a distinct disease or only a symptom of several affections.

DR. FRANCIS P. KINNICUTT said that his views were quite in accord with Dr. Osler's in reference to the lack of relation between chlorosis and pernicious anæmia, and for the same reasons. In his own clinical experience, and he had been much interested in blood examination for several years, he had never seen true chlorosis in the male. On the contrary, his cases of pernicious anæmia, which were considerable in number, had occurred, with one or two exceptions, in males. He had been in the habit of insisting upon the same points of difference in the conditions of the blood in chlorosis and pernicious anæmia mentioned by Dr. Osler.

He quite agreed with Dr. Henry in regard to the relation between pseudo-leukæmia, or Hodgkin's disease, and true leukæmia. He had had the good fortune to have under his observation for two years a case which presented the typical symptoms of Hodgkin's disease. When this case first came under observation the proportion of the white to the red corpuscles was normal. At this time there was marked enlargement of the superficial glands, and of some of the deeper glands, as shown by pressure effects upon the trachea and bronchi. The patient was constantly under observation until the disease ended fatally. He observed the spleen gradually enlarge until it reached extreme dimensions. The liver enlarged, and the blood, from being normal in its proportion of white to red corpuscles, presented the typical features of true leukæmia. The proportion of white to red at last was one to five or six. The man died of asthenia.

DR. W. W. JOHNSTON: I was much interested in the paper of Dr. Henry, especially in that part where he associated the chronic cases of anæmia with disease of the intestinal glands and of the gastric tubules. I think that the history of certain anæmias in women throw a great deal of light upon his remarks. We know how difficult it is to cure cases of chronic anæmia occurring after parturition. The explanation of these cases is that the long-continued pressure upon the intestinal tube, and the long process of starvation, lasting nearly a year, produce an actual organic change in the intestinal and mesenteric glands, and, therefore, even when the cause is removed, the atrophy continues, and remains incurable.

I should like to refer here to a case which at one time was under the care of Dr. Mitchell. It was the case of a young woman who voluntarily starved herself for a long period of time. When under Dr. Mitchell's care she was nearly at the point of death. She was, however, brought out of this condition, and remained anæmic and emaciated for many years with curious symptoms. Among these was melancholia, with delusions. This lasted a year. She then began to improve under artificial and forced feeding, and now is well, but the gastric and intestinal atrophy has continued. The atrophy of the digestive tube is demonstrated by the fact that she can digest only a small quantity of food, which must be taken at short intervals; the bowel movements are of pipe-stem size; she never has a natural, large movement. I think that there is here concentric hypertrophy of the intestinal wall, probably of the large intestine. We see that this condition, which is brought about

more or less during pregnancy, and by starvation, may remain as a permanent condition.

I should like also to refer to another case which has been under treatment for many years. It is that of a young married woman, who has the most compressed thorax and abdomen that I have ever seen, probably from the use of corsets, although this has never been admitted. She had persistent anæmia, which came on in girlhood, became worse during early married life, and finally culminated in those severe neuralgic symptoms which we sometimes see with anæmia. She suffered with neuralgia in the nerves of the forearm, arm, and the ball of the thumb. After long insisting, I persuaded her to go to bed, where rest and forced feeding were kept up for some time, and resulted in a partial cure. She now suffers no neuralgia, but still has a less degree of anæmia.

There is much more that might be said, but I wish merely to call attention to, and enforce this idea of the association of persistent anæmia with atrophy of the organs concerned in digestion.

DR. ISRAEL T. DANA: I wish to present a thought or two from a purely clinical point of view. It seems admitted, so far as the discussion has gone, that Hodgkin's disease is an independent, individual disease. Looking at it from an outside point of view, I think there can be no question of that. Some five or six months ago, a practitioner in my neighborhood told me that he had a very peculiar case, of marked individuality, one which he had never seen before, and asked me to see it. It proved to be a typical case of Hodgkin's disease. The enlargement of the glands in the neck, axillæ, and groins was very marked.

Looking at it from the same clinical point of view, I think it would be unfortunate to give up the individuality of progressive pernicious anæmia. The phenomena of the disease are so marked. Not only is there anæmia, but it is essentially a pernicious anæmia, going from bad to worse until the fatal issue within a given period of time, generally ending within one year. It differs in this respect from simple anæmia and from chlorosis.

In a case of progressive pernicious anæmia, under my care within a year, I happened to be present at the death of the patient, a man twenty-two or twenty-three years of age. He passed away as though a minute but constant stream of blood were flowing from some tiny vessel, and gradually reducing the quantity or quality of the blood below the point at which vital action could be maintained.

DR. WILLIAM PEPPER: It would seem to follow from the statements that have been made that pure anæmia and true chlorosis are capable of very distinct separation and recognition. As to the relation of true anæmia and true chlorosis to progressive pernicious anæmia, so called, I confess that I find myself in the position of Dr. Osler, not prepared to admit the analogy between chlorosis and progressive pernicious anæmia, and disinclined to speak positively upon the subject of the latter, owing to our want of the essential data

—very probably even the essential anatomical data. In chlorosis, the condition of the blood is very different from that found in progressive pernicious anæmia. The class of subjects in which it occurs is different. It is more curable. It is in these respects so distinctly opposed to progressive pernicious anæmia that it would seem that the latter should still be regarded as a widely different and independent disease.

I recognize the force of what Dr. Henry has said in regard to the transitional stages of the blood in the leukæmias, especially as regards the varying number of leucocytes. This is a pertinent comparison, as indicating that corresponding transitions may take place in the amount of iron found in different stages of chlorosis. I should, however, not base a radical distinction upon this fluctuating quantity. Granting this its full weight, it does not seem to me that it is capable of overcoming the vast clinical differences. If it were nothing but the changes in amount of a single and fluctuating element, I should think that it had little weight, but when this is joined with immense clinical differences, it is worthy of serious consideration.

Nor do I see how we make the matter easier by saying that progressive pernicious anæmia is a process and not a disease. If we were sure that we had said the last word in regard to essential anæmia; if we knew whether there be or be not a microörganism, or whether there be or be not some function of the liver, or anatomical stratum in the liver charged with the duty of supplying the red globule with iron, and that this function or anatomical element was the seat of change; if we could speak dogmatically on these questions, we should be in a different position. We have a state of the blood which, when it occurs with a peculiar group of clinical symptoms, we call progressive pernicious anæmia, and it constitutes a distinct clinical picture. If we find the same state of the blood arising in a certain percentage of cases of gastric cancer, or if we find it in gastro-duodenal follicular atrophy, it does not appear to me to destroy the identity of progressive pernicious anæmia, which is characterized by a clinical group of symptoms attended with this state of the blood from beginning to end, not altered by treatment, and not attended with any adequate causal condition that we have yet been able to detect. It would seem wiser, in our present state of knowledge, to regard essential anæmia as an independent affection. This discussion has rendered our views upon this subject more exact, and I believe that the recent work which has been done, and especially that of Hunter, encourages us to hope that we may yet arrive at a more complete knowledge.

Dr. F. P. Henry: I see that Drs. Osler and Kinnicutt adhere to the definition of chlorosis which has prevailed ever since the researches of Duncan in 1867, viz., that its essential feature is a percentage of hæmoglobin less than that of the red corpuscles. In my opinion there is nothing characteristic in such a condition. The first stage of all anæmias, whether occurring in the male or female, is, in my experience, a diminished percentage of hæmoglobin; at a later stage the corpuscles become reduced in number. I venture to assert that if the blood of every individual in this room were examined, there would

be found a large percentage in which, with a normal number of red corpuscles, the percentage of hæmoglobin would be found below par. These gentlemen would then be suffering from chlorosis, according to the definition just given. The fact is, that too much stress has been laid upon Duncan's observations. They demonstrated the fact, previously unknown, that the red corpuscles may be reduced in value as well as in number, and as they were made in chlorotic individuals, it was hastily assumed that such a condition is peculiar to chlorosis. The fact is, that the blood-changes in chlorosis are various, and, therefore, there is no room for regarding it as a special form of anæmia: 1. The corpuscles may be normal in number with a diminished percentage of hæmoglobin, their size being normal. 2. The principal change may be a diminution in the size of the corpuscles. 3. They may also be diminished in number. 4. The alkalinity of the blood is increased, and is, according to some, the most characteristic change. The fact is, that there is nothing characteristic of all cases of chlorosis, which is neither more nor less than the anæmia of puberty.

That chlorosis is readily cured is undoubtedly true in its early stages, but let such a case alone for months or years, and I venture to say that the cure will not be so easy. On the contrary, the type, instead of remaining benign, will, in the course of time, become pernicious.

The transition between chlorosis and pernicious anæmia may be seen in the ascending as well as in the descending scale. There are cases of pernicious anæmia which recover, at least temporarily, and as they improve the corpuscles pass through a stage which is universally accepted as belonging to chlorosis by those who contend for the independent nature of that affection—that is to say, they become of normal size, lose their irregular contour, increase in number, perhaps reach the normal number, but the percentage of hæmoglobin remains below par. The case which, seen at its worst stage, would be considered one of pernicious anæmia, would now, with equal certainty, be regarded as one of chlorosis. I have seen several such cases, and reported one in *The Medical News* for July 3, 1886.

SUBJECTIVE FALSE SENSATIONS OF COLD.

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THE present brief paper is simply meant to draw attention to a single symptom, which has not, hitherto, received sufficient notice; it is not of extreme rarity.

The cases I shall here report are characterized by the fact that the patient complains of local or general coldness, and that, as a rule, the parts involved have no abnormal temperature, or have one the reverse of that complained of. No doubt there are in medical literature many such records, but they must be buried in cases which, being reported under other titles, are difficult to find. In the catalogue of the Army Medical Library there is no heading which covers this symptom.

The meagre material which I possess could, with time, have been made larger, as I find that almost every physician has met with cases of the kind I am about to recount. I have enough, however, to enable me to make a rough division of my cases into at least three classes.

No. I. has a central cause and must be of great rarity.

No. II. is frequently due to neuritis and is not very uncommon. It contains cases which lack the remaining qualities of neuritis, and may or may not be due to local inflammatory nerve states.

No. III. is inexplicable or hysterical, and the phenomena are commonly unilateral, as in the first class.

As these cases have not occurred to me in such competent numbers as to enable me to generalize largely, I shall relate them with such comment as each suggests.

CLASS I.—In this class I have but a single case, but it is so remarkable that I am glad to present it for consideration.

CASE I.—Sir P. Broke was seriously wounded in the head in the fight between the "Chesapeake" and the "Shannon," in 1813. He received a severe

sabre wound while boarding the "Chesapeake." Of the later consequences of this wound I find no very distinct account in the loosely written and tedious biography of the patient.

On August 8, 1820, Sir P. Broke had a fall from his horse, which he described as follows:

"I was stunned by the fall, but it was only for a moment, for I was certainly dragged only a few yards; and I chiefly remember, as my first perception after the fall, that I was lying on my back and looking upward at my foot in the stirrup. I certainly got up unconscious of injury and walked about a quarter of a mile to my mother's house, whence I had just departed. I remember nothing of this walk, and my recollection recommences with my sitting down quietly in the room and telling her I had had a fall. I began in a few minutes to have some sense of stupor, as from a blow on my head; and having gone up stairs to wash the dirt off my head, I then discovered that my head was scratched in several places, and bleeding. The stupor became more oppressive and I sent for a surgeon, who bled me in the left arm, taking away ten or twelve ounces of blood. This might be about an hour and a half after the accident. The stupor increased considerably; I was persuaded to go up stairs again and to go to bed. This I clearly remember, and that while pulling my clothes off a violent retching and vomiting came on, and then my memory again failed me for several hours; but on the following morning I was perfectly clear again and had some good sleep. I felt the usual soreness in the head from such contusions, but had no hurt in any part of the body nor any uneasiness in my stomach, and my appetite was unimpaired. I felt weak, but unconscious of any material injury beyond the bruises I had received.

"The usual treatment in such cases was resorted to to prevent inflammation, and successfully, though my bodily powers were thereby, of course, considerably weakened. The first symptoms that I remember of any affection of the nerves were my perceiving, in the afternoon of the day following the accident, an extreme sense of cold in my leg and foot and left hand, so that I could not sleep in comfort without a worsted glove and worsted stocking; and in the course of the next day I discovered that the whole of the left side was strangely affected, the sense of cold appearing to lie internally upon the coating of the bones of the arm, thigh, and leg; and that, though the flesh externally was warm to the touch and generally in a state of perspiration, and though the skin appeared perfectly fresh and smooth, without any sign of withering or contraction, yet that skin over the whole left side of my person was affected with a singular numbness to the touch.

"After a time it became necessary to consult Sir Astley Cooper, who wrote to Dr. Lynn in the following language:

"'I have heard from Sir P. Broke a minute detail of his feelings and an accurate history of his case. The situation appears to be as follows: On the left side of the head the sabre cut has depressed the bone and compressed the brain, and as the edges of the fracture, which are displaced, have long since united to the skull, all expectation of any change in that part must be aban-

doned, and the diminished nervous energy of the right side, consequent upon this injury, will continue without variation.

"'Not so in the right side. There the mischief has been an extravasation of blood upon the brain or its membranes, and from decussation of nerves from the brain to the body the left side is suffering from diminished temperature, or power of resisting its changes, and from altered sensations. The heart is subject to occasional alteration in its functions from diminished nervous excitability, and hence the pain felt in its region, and the sense of strangulation under which Sir P. Broke occasionally labors. The stomach is also occasionally suffering from its sympathy with the brain, and hence those attacks which drinking warm water alleviates. Congestion in the brain from changes in position and from over-exertion of mind, tend to a sudden increase of all the symptoms; but this is temporary only. The probability is that the blood will gradually absorb if Sir Philip's general health be supported and he avoids too much mental excitement, and he preserves his body from humid circulation.'"

Nothing is said further either by Sir A. Cooper or the biographer of Sir Philip in regard to the very interesting symptoms described; but in Guthrie's *Military Surgery*, where first I lit on the case, that author thus describes it:

Admiral Sir P. Broke received a cut with a sword on boarding the "Chesapeake," on the left side of the back of the head, which went through his skull, rendering the brain visible; the wound healed in six months, although splinters of bone came away for a year. A second cut on the right side did not penetrate the bone. After a temporary paralysis of the right side, he recovered, with a loss of power and a disordered sensation in the second, third, and little finger of the right hand, aggravated by cold weather and by mental anxiety.

Seven years afterward, he fell from his horse, and suffered from concussion of the brain, which added to his former sensations by rendering the left half of his whole person incapable of resisting cold, or of evolving heat. In a still atmosphere abroad, at 68° Fahr., he said, "the left side requires four coatings of stout flannel, which are augmented as the thermometer descends every two degrees and a half, to prevent a painful sense of cold; so that when it stands at freezing-point the quantity of clothing of the affected side becomes extremely burdensome. When exposed to a breeze, or in moving against the air, one or even two oilskin coverings are necessary in addition, to prevent a sensation of piercing cold driving through the whole frame." Moderate horse exercise and generous diet improved the general health; the warm bath caused a distressing effect; the shower bath, cold or tepid, increased the paralytic affection. Frictions, with remedies of all kinds, increased it also, and so did sponging with vinegar and water, as well as any violent, stimulating quick excitement, or earnest attention to any particular subject. The Admiral died unrelieved, twenty-six years after the receipt of the injury, of disease of the bladder.

Owing to the rather vague statements of the surgeons and the biographer, we can only infer that the fall may have given rise to a rupture

of a vessel, supra- or sub-meningeal hemorrhage, slight motor loss, and irritative disturbance of sensory regions, causing numbness of the opposite side and false sense of cold.

Occasionally, in hemiplegia, coldness is a symptom mentioned by the patient, but not much complained of. I recall no case like this one, but I have distinct remembrances of at least two instances of probable clots involving the internal capsule and optic thalamus, causing lack of muscular sense and numbness on the left side. In both, unilateral sense of cold was felt, although there was no fall of temperature. In one of them the anæsthesia was notable, so that pin-pricks were not felt, and did not bleed. Both were adult males.

In cases of hemiplegia, it is desirable to know not only the actual temperatures of the two sides, but also how well cold and heat are distinguished on both sides; and, lastly, if there be abnormal subjective sensation of either cold or heat on the palsied side; and, too, the date of this symptom relatively to the attack—because, clearly enough, even in a cerebral paralysis, the later coming on of false feelings of cold or heat in the extremities may be due to peripheral neuritis, which would be highly unlikely were the symptom unilaterally generalized or of early onset.

CLASS II. *Local sensations of cold without lowered local temperatures.*

The three cases which follow are none of them as full as is now desirable, because the notes were made as mere memoranda for use in the conduct of the cases, and before I began to feel a larger interest in the symptom. All three were affected in the lower half of the body —two of them especially in the buttocks, which is a not rare seat of the symptom in question.

CASE II. (Case 281 in Note-book.) *Local sensation of cold in the buttocks.*—J. P., single; farmer; aged fifty-three years; Connecticut. The patient was a man of fortune, and had gone through a variety of excesses, chiefly sexual, which had resulted in causing what appeared to have been acute neuritis in the extremities, and in the smaller nerves which supply the subcutaneous tissues. There had been attacks of pain in the legs, arms, and back, and these had been, in a measure, relieved by various means before he came under my care. He also had a variety of vague gastric symptoms, which grew out of the hypochondriacal state. He had had tingling of both legs and feet; some loss of power in the right arm; tenderness upon pressure along many nerve-tracks and a difficulty of using his brain for prolonged mental exertion, which I believe to be of small moment. There was little

that was notable in the condition of sensation or of the electrive states of the muscle or nerves. His station was remarkably good; anterior sway two inches, dextral sway not more than one inch. The knee-jerk was lessened on both sides to one inch, but was very easily reinforced by motion and sensation. Sexual power was lessened. Superficial reflexes were normal.

The one symptom for which I have mentioned this case was the constant complaint of coldness. This, in brief, was his history. He had had gonorrhœa, but never syphilis.

When seen by me he was ruddy, in good flesh, and had no organic disease of any of the viscera.

The nerve-tracts above the waist were not sensitive, and he had long been free from neuritic symptoms of the arms. The two sciatic nerves were slightly tender from the exit points to the knee. The electrical tests gave normal results. The station was antero-dextral and good; knee-jerk, right seven inches, left one inch, but sensory reinforcements gave knee-jerk three inches or more right and left. Motor reinforcements added about two inches right and left. Superficial reflexes were normal. Sexual power somewhat lessened. Excessive exercise increased the tenderness, and also exaggerated the sense of coldness. This symptom began to be felt before he complained of distinct pain in any region, and his aches were so much better that it was merely the coldness which brought him to me. This was a positive ache and most distressing. It affected both buttocks, and the upper half of the back of both thighs, and was as intense as if he were seated on ice. Occasionally the calves suffered.

I saw him but once, and I do not know how the case resulted. The parts complained of were warm to the touch, but I took no note of the actual local temperatures.

CASE III. (Case 840 in Note-book.) *Subjective sensation of cold in buttocks with actual elevation of temperature.*—J. P. C., coal dealer; aged fifty-two years. No syphilis or gonorrhœa; much on his feet; uses neither tobacco nor alcohol. Married, has two children. Family healthy and long-lived. The patient lives in a somewhat malarious portion of New Jersey, but has not, himself, been subjected to positive ague.

About eighteen months ago, having been more than usually afoot, and somewhat worried with business annoyances, he began to have a painful sensation of cold in the left gluteal region, and down the back of the thigh nearly to the knee. There was nothing of the kind in the other leg. This trouble increased gradually until it became so positively distressing that he was in constant discomfort. It has varied very little up to the present time, and although better in summer, is yet distinctly felt through the warmest weather. Heat at all times makes him feel comfortable, and the greatest amount of relief is obtained by standing with his back to a hot fire. As soon as he leaves the fire, however, the sensation of cold returns with all its vigor; and, in fact, rarely leaves him. There is no perceptible pain in the parts affected. His station is good; his knee-jerk is normal, 3½ inches, and capable of ready reinforcement, both sensory and motor. The ankle-jerk is present and reinfor-

cible; there is no clonus. Superficial reflexes exist in integrity. Electrical reaction of the limbs normal; water and bowel mechanism perfect, but he thinks that since this trouble began his sexual power has lessened. Digestion is good, appetite fair. All secretions normal. His eyes are exceptionally good, since he is not yet obliged to wear glasses. An actual examination of the temperature shows the left buttock to be distinctly warmer than the right; it was found to be one-quarter to one-half degree F. higher than on the right side. The exit point of the left sciatic was at times tender. He declares himself to be not as strong as he was. He is somewhat paler, and has lost from four to five pounds of flesh. Always in the morning, on rising, he is nervous—as he says, a "little trembly." There seemed to be no indications, except to look after the manifest failure of his general health. Quinine and arsenic had already failed, and long holidays in the mountains proved valueless. Iron was given in moderate doses, as well as strychnia and cod-liver oil. Within a week or two he began to gain health. His weight improved, but there was no relief from the sensation of cold. Accordingly, I advised local massage, but after its use the parts seemed colder than ever—that is to say, when the actual temperature of the parts went up ½° to 1° F. under massage the sensation to the patient was as if the part had become colder. He was under the impression that galvanic electricity locally was of service, but exercise did not improve his condition. After many months' treatment, during which I saw him occasionally, he had gained largely in general health and freedom from nervousness, and in capacity to do his work with his usual energy; yet, notwithstanding, there was the same constant sensation of local cold.

I think malaria may be ruled out as a cause of trouble. The most careful study showed no local tenderness, except as stated. There was at times, on long exertion, slight tingling of the left foot.

This case was one of real suffering; the ache of the cold was intense and disqualifying. In the light of other cases I suspect this to be a neuritic condition. The increase of warmth from massage was felt as cold, and this is interesting since he had a quite normal appreciation of applied cold and heat.

CASE IV. (Case 821 in Note-book.)—Mr. C. S., aged sixty-three years; glass manufacturer. Patient has no bad habits; has never had syphilis, or any other constitutional malady. He has been for many years an extremely active business man, weighted with many responsibilities and constantly afoot. There are no head symptoms. He sleeps well, and has a good appetite, and there are no gastro-intestinal troubles.

Five years ago he had some difficulty in passing water, and, later on, a return of the same trouble, which appeared on examination to be due to an enlargement of the prostatic gland, not a very serious matter. Within a few months he found that exercise tired him, especially mounting stairs.

There is now no cardiac lesion to account for the difficulty, and the arteries are in unusually good order. There is a distinct lack of power in both legs, and, in walking, he does not use the left foot as well as he should. His station is good; his sway, standing with his eyes shut, is antero-dextral, not exceeding an inch in either direction. The knee-jerk is normal, three and one-half inches; reinforcements are normal. There is no clonus, and no perceptible loss of sensation in the legs and arms, either as to touch, pain, or temperature. There is no tingling or numbness. The mixed urine of the night and morning contains two grains of sugar to the ounce, but no albumin or casts. None of these symptoms were such as to alarm him or cause him to consult me. He attributed them all to over-work, and to being too much afoot. He was, perhaps, in a measure, right.

That which drove him to seek my advice was a slowly increasing and very positive sensation of cold, from the waist down to the calves of the legs, and limited to the posterior half of the body. It was usually most severe on the right side, but varies a great deal, sometimes being felt more on the left. The sensation is described as being equivalent to that which would be experienced by sitting long on ice. It caused him to desire to cover the parts concerned with an excessive amount of clothing. As the cold was apparently lessened by motion, he kept afoot, when evidently his general condition demanded that he should not. He tells me that at times, under active motion, he has some sense of numbness down the back of the right leg in the region affected with false sense of cold. I could find no notable difference between the temperature of the two sides of the body in the regions where he suffered, but, as both had more or less of the same trouble, it was natural that the temperature should not differ greatly. Normal surface temperatures are apt to vary in different individuals, and to a far greater extent than interior temperatures. There is no standard so exact as to enable persons to compare with it surface temperature of a case like this; undoubtedly, however, the temperature was not below normal. The masseur, who rubbed him, insisted that at times the buttocks were warmer than they usually are.

My patient improved enormously under tonic treatment and proper diet; in fact, the sugar disappeared entirely, and he regained full health after a few months of care. The unpleasant sensation of cold was the last symptom to leave him. It is as well to say, in conclusion, that my patient was not a nervous man, nor was he hypochondriacal. He was rather disposed to underrate than to overrate his symptoms. The complaint he made of the sense of cold was most positive; at times the sensation was so distinct that he could hardly keep himself from believing that some cold application was being applied to the parts in question.

In this case there was no sensitiveness of the lower nerves, but a sharp blow on the sacrum with a rubber hammer was felt in a dull, deep pain, somewhat lasting, and it seems possible that in this, as in the other cases of buttock cold, there may be obscure commencements

of neuritic trouble in the cauda equina. The sensation of coldness of the buttocks is not excessively rare. I have seen it from time to time, and now that my attention has been directed to a possible cause, I shall, perhaps, be better able to relate the symptoms to a probable cause.

CASE V. (Case 935 in Private Note-book.) *Subjective sensation of cold in the right foot, with actual increase of temperature in the parts.*—J. C., male, aged fifty-two. A native of Pennsylvania, by occupation a clerk. Has had perfect health. Never had syphilis. Stands on his feet at work for seven hours a day. Is married; has six children, all well. He lives in a country which is not malarious, a mountainous region 1000 feet above the sea.

About five years ago, Mr. C. found that his right foot became painfully cold after standing for a length of time, and even in a warm room he was inclined to dress that leg warmly—often wore two pairs of socks and an "arctic" rubber shoe heavily lined. Even at this early period he found that the parts affected were not cold to the touch, and were rather apt to be more flushed than the other foot.

As the summer progressed (and this has been the case nearly every summer since), the foot became better. At times all that summer it was tender, and was eased by his sitting down. In the winter which followed, the impression that the foot was cold was often so intense that he would go from his work and remove the covering from the limb and ask some one to examine the foot to see if it were not frozen. The observer called upon was apt to say that it felt warm to the touch. His general health remained good. He was able to do his work, and lived a tranquil life until a few weeks ago, when symptoms occurred which caused him to consult me.

I found him a man of fairly robust appearance, of good color, with no history of specific or malarial poison. His heart and kidneys were healthy, and there were no peculiarities which I need mention, except those concerned with the foot. About six weeks before he came to me—that is to say, the end of January, 1887—the foot became more and more troublesome, and he began to have also a tingling sensation on the right side of the head in the scalp, and also in the hand on the same side. These symptoms came on suddenly one day, when he was rising in the morning. They have now passed away. The other head symptoms of which he complains (and which he insists he did not have before the symptoms just mentioned), are a sensation of roaring in the head, accompanied with a throbbing in the vertex. The dynamometer showed good results for both hands. His foot and its conditions are what give him most trouble, and it is for these that he consults me.

Of the present state of his symptoms, he gives me the following account: He is better in summer than in winter, although at all seasons the foot becomes distressingly cold when he has been standing on it for more than half an hour. To sit eases it somewhat, to put it up on a chair eases it more; lying in bed for

some time gives him the greatest relief, as when he wakes in the morning the foot seems to be warm. An upright position has an immediate effect. He says, when that position is assumed, the leg seems to become cold to the knee. There is absolutely no difference in the appearance of the two limbs, whether in standing or in lying down. The knee-jerk on both sides is equal and normal, the other reflexes good, as well as the electric reactions. The sensory appreciations of all kinds are natural. Both feet are flatter than they should be, but I could find no trace of tenderness in either. The temperature of the right foot was 1° F. higher than that of the left foot. On one occasion, Seguin's surface thermometer (arbitrary) marked 6° difference of the right as above the left; and these peculiarities of temperature were the same when the left foot was placed in the same physical conditions as the right. The sciatic nerves behind the knee were quite tender. I did not study the temperature sense, as it was long ago, and I was not awake to the value of this as a symptom. Treatment proved of little value.

This case was, probably, also a neuritic affection. In some ways it resembles the remarkable cases which I once described as erythromelalgia. In them, however, there were pronounced vaso-motor disturbances, with excessive pain. Of late it has been pointed out that in some cases of positive neuritis the capacity to be aware of degrees of cold applied to the skin is present, while the like power to distinguish heat is lost.[1] This symptom existed in none of my cases; but I may not have too carefully looked for it. I have observed it in hysteria and seen the reverse condition, and also that heat could cause pain when the needle did not. But this part of symptomatology needs careful reëxamination. Meanwhile, I may conclude that intense sense of local coldness should cause us to suspect neuritis as a cause. I had, last winter, a sad case of general neuritis in a woman. Exercise increased it enormously, and when it became worse in any part there was in that nerve territory painful sense of cold, with very often rise of temperature and local enlargement of the veins, but no notable incapacity to discriminate temperatures.

I may add, as regards all these cases, that mere vasal states do not suffice to explain the false sense of intense local coldness. If they be of local peripheral origin, we must assume that the nerves are then constantly in a physical state such as is present when true cold is applied.

The condition of false sense of heat is to be met with, as is well

[1] George W. Jacoby: Journal of Mental and Nervous Diseases, June, 1889.

known. For myself, I have never yet felt sure that there are distinct nerves for perceiving heat or cold. Another theory is possible, as I have elsewhere stated in regard to pain and touch.

My next case of intensified capacity to feel cold stands alone, but, I am sure, it will not do so very long. I owe it to the kindness of Dr. Kinnicutt. Exactly the reverse state is to be seen most often in the insane, but I reserve the cases of false sense of heat, local or general, for another paper. They offer greater difficulties.

CASE VI.—L. P., Kansas, aged fifty-seven, lawyer. When a youth, seventeen years ago, the patient suffered from a renal complicatin during an attack of scarlet fever. Albumin has been found almost constantly in his urine from that date, and casts very frequently. He has, nevertheless, enjoyed good health, and although his urine still contains albumin, and hyaline and granular casts are occasionally found, he is in excellent condition, and performs all his varied legal duties easily. On careful examination there are no signs of cardiac or vascular changes. The heart is *not* hypertrophied. There is no marked arterial tension, and no appreciable change in the vessel walls.

For the past six or seven years he has been greatly annoyed by subjective sensations of cold. These sensations are general, but are particularly marked along the inner aspect of the upper arm; they are greatly increased by mental application. To relieve these sensations, he wears at present three suits of the heaviest woollen under-clothing, three pairs of the heaviest woollen socks, felt boots made expressly for him of the heaviest material, over his ordinary boots or shoes, and a flannel bandage around the abdomen. At night, he wears two of the above suits, a flannel chest protector, and the woollen socks. He sleeps under five double blankets, on a feather mattress with a hair one underneath. Moreover, he is obliged to keep the night temperature of his room at 80°, and after an unusually hard day at court, at 90° or 95°.

The only change of underclothing that he makes in summer is the doing away with one of the three suits. The sensations of cold are positively painful. I have made inquiry as to the truth of his statements concerning the amount of clothing worn, and they are borne out by my examinations. The surface temperature is normal, even when he complains most bitterly of his symptoms. He has a highly sensitive and nervous organization, with an active mind. He is well-balanced, cheerful, and philosophical about his sufferings. He walks from five to six miles daily without fatigue; on the contrary, with benefit. He is absolutely free from the ordinary symptoms of hysteria, and has no pain and no tenderness along the nerve tracts.

This case is calculated to make us reflect upon the ordinary standards of heat and cold. They vary with individuals, with the masses of people, and with periods of life, as the aged well know. The present case is that of a man abnormally susceptible to cold. Explanation I

have none to offer. It is interesting to be assured that a man may have tube-casts in his urine for forty years and yet preserve a standard of general health and activity.

CLASS III.—Finally, I give a case of false sense of cold in an hysterical woman. Such cases must be rare. The reversed state I have also seen in the hysterical more than once.

CASE VII. (Case 409 in Private Note-book.)—Miss B., aged thirty-three years, Penna. The patient in this case was a young woman in easy circumstances, for many years a victim to hysterical conditions, first acute and afterward chronic. To describe her case would be to describe almost every form which hysteria assumes.

At seventeen, she began to be irregular as to her menstrual periods, and at last passed into a condition of hysterical stupor, then into catalepsy, and later had for several weeks onsets of hystero-epilepsy. At last, coming out of this condition, she suffered for a long while from attacks of rigidity, the left leg finally remaining at an angle to the trunk and knee. Next, several months passed away, during which she continued subject to slight hysterical attacks, and then by degrees improved so as to be fairly well. She was a bright, emotional, and a very intelligent woman, fond of reading, and devoted to music. She exercised but little, however, and was, when I first saw her, again drifting into a life of invalidism.

About two months before she came to me she passed over one menstrual time, and during the month which followed, began to have a sense of cold on the left side of the body. This condition arose quite gradually, and became at last so violent as to compel her to wear, on that side, two or three times the amount of clothing required on the other. This excessive increase of clothing made her so ridiculously one-sided that she was ashamed to be seen in public. She continued to dress in this peculiar fashion, rarely leaving the house, and presented an appearance more easily imagined than described.

I first saw her early in February, 1883. She was then a woman of fair general appearance, with nothing notably wrong in any organ, and with all the secretions in good order. She had had no hysterical attack for several months. Menstruation was natural, almost without pain at her last period. At this time, however, she complained of a difficulty in swallowing, and of a sensation as of a band around her throat. The whole left side of the body was still subject to the sensation of cold to which I have alluded, and which affected also the same side of the face, head, and neck. There was no loss of sensation to the touch on this side—in fact, there were hyperæsthetic spaces, one below the left breast, and one below the floating ribs on the left. This region of tenderness continued to the middle line and down to the pubes. The special senses were normal, and there was no change in the color fields.

DISCUSSION.

DR. JAMES J. PUTNAM: In chronic spinal disease and in chronic neuritis I have seen the coldness to which Dr. Mitchell refers. This was quite marked in one case which I shall report in my paper. This patient suffers from sensory neuritis which may possibly be due to lead. The sensation of cold is present to an extreme degree. In regard to the sensation of cold in persons not presenting signs of anæmia neuritis, I am not familiar with anything like what has been reported, though I have seen cases in which there were sensations of excessive heat, without organic disease.

DR. F. T. MILES: I think that the sensation of cold is a very important symptom of neuritis. I have seen it in one case of acute neuritis of the ulnar nerve followed by paralysis of the muscles of the hand. During the hottest summer weather the patient had to wear a great deal of extra wrapping on the arm. Often a sensation of extreme heat follows injury of the nervous system, either peripheral or central. I recollect that after the attempted assassination of Garfield, the description that he is said to have given of the feelings in his feet was that of extreme burning. I remember having expressed at that time the idea that the spinal cord was involved.

GASTRIC NEURASTHENIA.

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In 1878[1] Leube demonstrated the fact that many cases which had previously been grouped under the term "gastric catarrh" were clearly free from catarrh. The stomachs involved were organically and functionally sound so far as the gross results of digestion were concerned. To determine the gastric integrity of such cases he gave the now celebrated test breakfast (Probe frühstich) of beef, bread, and tea, and washed out the stomach during the seventh hour. In each of the special cases differentiated by him he found the digestion perfectly completed within the normal time.

On the other hand, accompanying this interval of normal digestion were the following complaints: congestion of the head, headache, dizziness, palpitation and pulsation of the abdominal aorta. In the intestinal tract itself the patient suffered from belching, pressure, fulness and tenderness in the epigastrium, pyrosis, anæmia, nausea, hiccough, yawning, and alterations of taste.

Leube argued that such discomforts must be due either to the irritation caused by certain chemical products of digestion acting peripherally or centrally, or they must be directly called forth by an increased irritability of the gastric nerves to ordinary stimuli. Inasmuch as chemical changes of food require a certain interval for their production, one would not expect the nervous effects until later in the process of digestion, whereas, in Leube's cases, the discomforts usually began immediately on eating. Therefore, he believed that they were due to direct mechanical irritation of over-sensitive nerves, and he grouped such cases under the title of *Nervöse Dyspepsie*. He considers this dyspepsia an independent affection, and one that must be

[1] Leube: Deutsche Arch. f. klin. Med., 1878, p. 98.

carefully distinguished from the nervous phenomena which accompany gastric catarrh, ulcer, cancer, etc.

"We should apply the term nervous dyspepsia," he says, "only to such abnormal cases as present no anatomical obstacle to the assumption that the nervous system, and particularly the gastric nerves themselves, are exclusively involved in the production of the trouble."

Following Leube's paper, there arose an active discussion as to his assumption that the syndrome described by him was due to a local affection of the gastric nerves. It had been previously well known that gastric crises of varying degrees and kinds were associated with certain central lesions of the cerebro-spinal axis. Working upon the lines suggested by Leube, it was soon found that neurasthenic patients, having no central nervous lesions, were presenting all kinds of gastric phenomena, which were simply the results of nerve-storms sweeping through systems endowed with deficient inhibitory powers. Hence nervous dyspepsia has secured a place in the category of neurasthenic accidents.

Stiller[1] has divided such gastric neuroses into *idiopathic*, *reflex*, and *general* neuropathic types. Inasmuch as this arrangement necessitates considerable repetition, Oser[2] and Glax abandon the etiological basis, and draw upon the physiological functions of the stomach for the classification of the disorders. The following arrangement, modified from Glax and Oser, seems on the whole to be the most simple:

- Secretory neuroses,
  - Irritative forms,
    - Gastroxynsis.
    - Gastrosuccorrhœa.
  - Depressant form, — Deficient secretion.
- Sensory neuroses,
  - Alterations of physiological sensations,
    - Hunger . . . .
      - Increased,
        - Heisshunger.
        - Wolfhunger.
        - Bulimia.
      - Diminished.
      - Absent—Anorexia nervosa.
    - Satiety. . . . .
      - Increased.
      - Diminished.
      - Absent.
  - Pathological changes,
    - Feeling of motion and of burning.
    - Nausea. Pressure.
    - Gastralgia. Cardialgia. Gastrodynia.
    - Hyperæsthesia.

[1] Stiller: Die Nervösen Magenkrankheiten, 1884.

[2] Oser: Die Neurösen des Magens, 1885.

- Motory neuroses,
  - Hyperkinesis,
    - Peristalsis and antiperistalsis.
    - Eructation. Belching.
    - Nervous vomiting.
    - Cramps in stomach,
      - General.
      - Cardiac.
      - Pyloric.
  - Hypokinesis,
    - Atony of the stomach,
    - Insufficiency of cardiac orifice,
    - Insufficiency of pylorus,
    - } Regurgitation or merycismus.
- Vaso-motor neuroses.

The time allowed for this paper will not admit of an extended discussion of this classification, and no doubt cases occur to each one of my hearers which readily fall into place in the tabular arrangement without further explanation. I desire merely to describe a few cases which have occurred to myself, and note their position in the list.

The first case is one which seems properly to come under the group of sensory neuroses; it is

Anorexia Nervosa.

CASE I.—*May*, 1884. Mrs. T., widow, sixty-three years of age. Patient has never been very strong. Had an attack of dysentery one year ago, and is troubled more or less with piles. She complains of great weakness, which comes on by spells, and she has a tired feeling all over. Sleeps well. She has *absolutely no appetite.* She gets out of breath going upstairs, and vomits often. Occasionally has dizzy spells following the vomiting, and some headache. The bowels are pretty regular, but inclined to looseness on provocation. She looks very pale, and dark around her eyes, and has a melancholy, depressed expression. There is no cough. Her chief complaints are weakness, and entire absence of appetite. There is a systolic murmur at the apex of the heart. Forced feeding and tonics gradually restored her to her usual strength after several weeks.

January, 1886. Mrs. T. began to complain of numbness and prickling in the tips of the fingers on both hands. The touch of woolly materials was very disagreeable to her. In the following March she summoned me, and complained of three things: the distressing prickling of finger-tips, no appetite, and weakness. She grew gradually weaker and weaker until April 8th, when she became unable to go about any longer, and kept her bed. Temperature and pulse were normal; urine also normal. She lay in bed four weeks, and was fed every three hours on milk, Mellin's food, broths, wine, etc. She gradually lost her sense of prostration; her bowels became regular. Tonic medicines were administered as her stomach would bear them. Her tongue was always red, and never coated. When she first began to walk, her legs were excessively weak, so that she staggered and fell against articles of

furniture. She could not lift her feet, but hitched them along. In May, 1886, I tested the knee-jerk, and found that it was absent. Under prolonged use of massage, forced feeding, and tonics she slowly regained her usual health, and numbness and prickling of finger-tips almost disappeared. During this entire illness she never complained of anything except repugnance to food, weakness, and prickling of finger-tips.

August, 1889. Patient applied to me again on account of poor appetite. When she entered my office she looked so pale and wan that I thought she would faint away. She said her appetite had been failing for six months, and since hot weather set in it had gone entirely. There were days when she would feel as well as ever, except for weakness and absence of appetite. Sometimes she would taste nothing all day long until evening, when she would force herself to take a teaspoonful of Murdoch's food. She has been able to go about the house at will, and she had particularly noticed that during the spring she was able to walk up two flights of stairs from her dining-room without palpitation or shortness of breath. Since her appetite left her completely, she has lost flesh and grown very nervous. A very little excitement will prevent her from sleeping. Tongue is red, and has no coating; its edges are sore with canker spots. The patient has no nausea or vomiting, however, and food when eaten does not distress her. It apparently digests all right, although, as I have previously noted, her bowels are inclined to looseness if she indulges in fruit or indigestible food. At present her bowels are regular. She complains of no belching, no eructations of gas, and no acidity in throat. The urine was found normal. The murmur at the apex still persisted, but was very faint, and the action of the heart was otherwise normal. She was put upon tonics and forced feeding—a teaspoonful of some kind of food every fifteen minutes.

We have here the history of a woman of feeble constitution and a small fund of reserve energy, who digests her food without any consciousness of the process, and whose bodily functions are practically normal in every way except that she suffers at times from an absolute anorexia. The term anorexia nervosa was originated by Sir William Gull, and indicates that loss of appetite is the chief and characteristic feature of the case. J. Matthews Duncan[1] says:

"A good example is one of the most ghastly spectacles you will meet with in practice, but the sadness of the picture is relieved by the fact that they all recover, and recover completely. I dare say the disease occurs in men, but I am not aware of a case. The patient loses appetite and becomes emaciated. The catamenia cease, and, if the woman is married, fecundity is arrested. The bowels are very constipated, the stools dry and hard. There is no increase of desire for attention and sympathy; on the contrary, the patient is

[1] J. Matthews Duncan: The Lancet, May 18, 1889.

rather inclined to reserve and seclusion. The patient makes little or no complaint; it is her friends that complain for her. There is no noticed weakening of the mind. There is great desire for exercise, especially walking exercise; the patient has a degree of festination, and does not get tired, does not want to rest. Here you recognize a disease quite different from hysteria and neurasthenia."

For cases of this character Wiessner[1] recommends the *gavage* of Dujardin-Beaumetz. He employs a short rubber tube which reaches just below the cricoid cartilage, and is attached externally to a bottle or funnel containing the liquid food. The tube is easily introduced, and, although it occasions some retching at first, the patient soon becomes accustomed to it. On removal the tube should be tightly pinched to prevent any of its contents from dropping down the larynx and trachea. The food should be liquid, and should not be introduced too rapidly, or it will excite attempts at vomiting.

Wiessner figures that about 100 grammes of albumen, 150 grammes of fat, and 300 grammes of carbo-hydrates are a sufficient amount of daily nourishment. Accordingly he mixes up 2 litres of milk, 60 grammes of butter, 6 eggs, and 100 grammes of sugar, and warms them while stirring. He gives a third of this amount three times daily. He says the patient soon finds she can digest her food, and she is encouraged to eat for herself.

The next three cases I classify under the term *vomitus nervosus.*

CASE II.—Miss S., began at two years of age to have sudden attacks of vomiting, in which she expelled a quantity of bile, and then recovered. She had three attacks at that time, in three months, and from then to the date of her death she was subject to similar seizures at irregular intervals. Her mother always called them bilious attacks, and said that they were most frequent in the fall of the year and after the first cold snap. The mother always expected an attack when the child appeared extra well and vivacious, and it usually came the next day. The vomitings generally lasted twenty-four hours, and then it took a week for the child to recover her strength.

She had scarlet fever at six years of age, and it was ushered in by a violent attack of vomiting and muscular twitchings. Subsequently the measles were similarly introduced. She broke her arm during her sixth year, but had no serious disturbance with it.

At eleven years of age Miss S. had a slight attack of St. Vitus dance, and was removed from school for two years by advice of her physician. The menstrual flow was established at thirteen years of age, but it had been pre-

[1] Wiessner: Nervöse Dyspepsie. Inaugural Dissertation, Berlin, 1888.

ceded for six months by a peculiar pain in the abdomen, which disappeared when the menses began.

As Miss S. approached the age of twenty she began to develop a new symptom in association with her so-called bilious attacks. Whenever nauseated, she would experience excessive muscular twitchings of the entire body, which, increasing in energy with the progress of the nausea and vomiting, would finally be sufficient to throw the body all over the bed. The contractions were never tonic. There was no opisthotonos or prolonged tension of any kind, but simply a violent commotion of the muscles, which was not attended by pain, but was uncontrollable by the patient. When seen in such an attack by the writer, the patient was apparently perfectly calm mentally and in full possession of her senses, without excitement of any kind, and she usually tried, but in vain, to exert restraint upon the bodily movements. There were no hysterical mental phenomena whatever. There seemed to be merely a loss of inhibitory power, and the muscles ran riot. These same twitchings occurred on ship-board during sea-sickness.

In the fall of 1882, when Miss S. was twenty-two years of age, she began to have severe headaches, which gradually increased in frequency until the spring of 1883, when they were merged into one steady ache. The patient was naturally of a very dark complexion, but at this time she lost flesh, became very sallow, and was prostrated by any ordinary effort of exercise, and was very despondent. She was treated during the summer by Chapman's ice bags to the spine, prolonged hours of rest in bed, and general tonics, and gradually recovered her flesh, strength, and good spirits. During the fall and winter she was apparently perfectly well.

Jan. 1, 1884. I was summoned, and found her in bed with an intense headache and a slight twitching of the arms and legs. On the next day vomiting began, and the twitchings were violent, so that morphine (one-eighth grain) was administered to stop them. Two subcutaneous injections of morphine per day were all that were required. The bowels were constipated but were relieved by aloin. No food was retained by the stomach. Patient after vomiting some time complained of intense burning and rawness in the throat and stomach. The tongue was sore and the mouth dry. Improvement set in on the fourth day, and she began to eat on January 6th.

9th. Found her better of other troubles, but her tongue was very sore with canker spots along its left border. The left half of tongue swollen, tender, and very red. This swelling, redness, and soreness subsided in a few days under local washes.

13th. She ate a piece of brown bread and took some beef tea. She soon began to vomit, and passed through her previous distress again. The vomitus consisted of thick, viscid mucus, stained with bile. Stomach was painful and tender to pressure. Evening temperature was 100.8° F. Pulse 100.

14th. Temperature 99.6°, pulse 96. Gradually recovered from this attack until January 27th, when she had a third, which lasted a few days. She was fed by the rectum for three days during this attack. She enjoyed exceptionally good health during the following summer and fall.

Nov. 12. Miss S. started on her last illness at twenty-six years of age. She was seized with an intense headache, loss of appetite, and malaise. On November 15th vomiting and twitchings began. She vomited once an hour, or oftener, for thirty-six hours. One-quarter of a grain of morphine was given every four or five hours. There was occasional hiccough, distress in stomach, with burning and dryness of the mouth, tongue, and throat. The headache persisted, and the eyes became blood-shot. The micturition caused trouble during one night, but afterward occurred naturally. The epigastrium grew very sensitive and the face sallow.

After the vomiting ceased, she was fed on teaspoonful doses of Mellin's food and milk, which amount was gradually increased as the stomach bore it. Dejections were obtained by enemata, but caused prostration. She seemed to be gaining slowly but steadily until December 2d, when all the regular symptoms began again without any discoverable cause. She took breakfast at 4 A.M., consisting of ten teaspoonfuls of Mellin's food and milk, and one teaspoonful of London beef essence. At 5 A.M., severe colic ensued, and lasted several hours, and then the vomiting, etc., began.

Dec. 3. Same story of vomiting. Morphine, one-quarter of a grain, subcutaneously every three hours. Pulse 68.

4th. Pulse 120, and weak. Temperature below normal. After violent attacks of retching there are occasional streaks of red blood in the vomitus. Patient had a few chilly spells.

5th. Stopped everything by the mouth. Gave two ounces of milk and two teaspoonfuls of brandy every three hours by the rectum.

6th. Vomiting beginning to diminish in frequency. Patient is occasionally flighty in her mind. Menses appeared. Pulse 140, temperature 97° F. The mother says this is the most persistent attack of vomiting that Miss S. has ever had. The longest previous attack lasted fifty-two hours, and patient is already upon the fourth day of vomiting now. She takes five-sixteenths of a grain of morphine every five or six hours, according to her symptoms; this produces sleep for about three hours, when she becomes restless and begins to vomit in about six hours. She does not complain so much of acidity and burning in the throat and beneath the sternum as formerly. She looks very emaciated; the eyes are sunken, hands cool, the tongue is slightly coated. The epigastrium is tender in the median line, but there is no tenderness along the border of the liver. There is no abdominal distention. There is occasional hiccough but not much twitching. Patient does not complain of thirst, and asks for nothing to drink or eat.

7th. Patient lay like a log with her eyes closed all day. No nausea, no suffering, no talk. Passed her water at 5.30 P.M., for the first time in twenty-four hours. Morphine was reduced during the day. She vomited only once, a mouthful, at 6 P.M.

8th. Pulse 130. Lies passive most of the time. Asked for food once. Can be easily moved. She was fed every three hours with about three teaspoonfuls of prepared milk.

9th. Still very quiet and apathetic. Yesterday there was noticed an offen-

sive odor from her body, and it was discovered that her beef injections were becoming putrid. The bowel was also inclined to be irritable and reject the enemata.

10*th*. Took a small amount of milk and Mellin's food by the mouth every fifteen minutes for two hours, and then waited two hours, then food as before; appeared to bear the food well. She was fed continuously by the rectum all this time. Morphine was withheld for nine and one-half hours to-day. Patient then grew restless and cried, and was very excited for a short time.

Up to this date nothing abnormal had been discovered in the urine, though it had been frequently examined. It now began to smell ammoniacal, and contained a sediment of pus, and there was a marked trace of albumin. Her temperature was 98.5° F. It is fair to add that Prof. E. S. Wood analyzed the urine on December 12th and found it alkaline. Specific gravity 1022. Sediment of pus, blood, triple-phosphate crystals, muscular fibres, fat, few epithelium cells (bladder or vaginal), and few dumb-bell oxalate of lime crystals. The muscular fibres showed that the urine was contaminated by leakages from the rectum, although the nurse took all possible precautions in collecting it.

12*th*. Urine is growing scanty in amount. Morphine was reduced to one-quarter grain in twenty-four hours.

13*th*. Passed a good night. Took six ounces of milk and Mellin's food by the mouth in twenty-four hours; also about twelve ounces of the same by the rectum; also three teaspoonfuls of brandy in each enema every three hours. Pulse weak, 104. At 1 P. M. pulse very weak, 104. She could not be aroused to reply. She swallowed food with difficulty. Allowed it to run out of her mouth. The breathing was very quiet.

In consultation with Dr. David W. Cheever, we injected one-twentieth grain of strychnine under the skin and gave a brandy and coffee enema.

She sank gradually, and died at 7.30 P. M.

The autopsy was made by Dr. W. F. Whitney, Curator of the Anatomical Museum, Harvard Medical School, who has kindly furnished me the following report:

"*Autopsy*, December 14, 1884, sixteen hours after death. Body of a slight girl, much emaciated, rigor mortis present, and lividity of the dependent parts.

"Skull thin, especially from absence of diploë. A slight protuberance on the left side near the groove of the anterior cerebral artery, but no corresponding depression on the surface of the brain. In the right temporal region at one point the dura mater had apparently disappeared and the bone beneath was slightly crumbling, but there was no increased redness about the edges nor any change in the contiguous surface of the brain. Considerable thin, watery fluid flowed from the surface of the brain, and the meshes of the pia were distended with it. Vessels of the pia engorged. Substance of the brain moist and pale, otherwise not abnormal.

"Heart normal in size; valves normal. Muscular substance slightly granular.

"Lungs did not fully collapse. Lower and posterior parts dark and red, distended. Watery fluid mixed with air flowed from the cut surface.

"Spleen small, follicles distinct.

"Stomach: Marked reddening of the inner surface with minute hemorrhagic points. Mucous membrane very thin.

"Intestine normal in appearance.

"Mesenteric glands normal.

"Liver: Periphery of lobules yellow and opaque. Numerous large, fat drops of varying size in the cells.

"Pancreas normal.

"Kidneys slightly enlarged, firm. Abundant blood in the pyramids. Cells markedly granular, here and there an occasional fatty one. Slight increase of intertubular tissue. Supra-renal capsules normal.

"Ovaries: In the right was a cyst as large as a peach-stone, with smooth inner wall. Left ovary elongated, firm, and contained a small corpus luteum.

"Bone marrow normal.

"Diaphragm: Numerous fatty, degenerative fibres. External and internal intercostal muscles extremely granular, striations lost, and every fibre more or less fatty.

"The diagnosis is atrophy of the mucous membrane of the stomach, but this is far from well marked. A very slight interstitial nephritis, but in itself of little account. The slight œdema of the brain had probably occurred at the very end in connection with the slow manner of death.

"The fatty degeneration of the respiratory muscles is undoubtedly a marked factor in the cause of death. Whether it can be placed as an original cause or one that has supervened on the persistent vomiting, future cases will have to decide."

In this case we have the history of a highly educated young woman, who was very active and prominent in her social circle and in the affairs of her church. She had had no severe diseases since childhood except the one history of the gastric attacks and their associated phenomena. The urine was frequently examined between 1884 and 1886, and always proved normal until a few days prior to her death, when it contained a trace of albumin but *no casts*. Moreover, at that time it was contaminated by the leakage from the rectal injection of albuminous substances. The slight organic change in the kidney, described by Dr. Whitney, was not sufficient to account for the case; moreover, the heart was perfectly normal in size. We should have expected some cardiac hypertrophy if the interstitial nephritis had been extensive or of long duration. Therefore, I have classified the case among those of a purely neurotic type. The father of Miss S. informed me that

he had suffered with indigestion and gastric discomforts all his life, and that these troubles were especially conspicuous during his youth. An aunt of Miss S. had been an inmate of an insane asylum.

CASE III.—Miss Sh., twenty-two years old, dark complexion. Very active society girl and very devoted to painting. Complained of headache, malaise, and loss of appetite during the spring of 1888. Early in the summer her parents took her to the sea-side, and later went with her to the White Mountains. I first saw her on September 19th, when I found her in bed complaining of severe headache, poor appetite, constipation, and weakness. She also had begun to speak of nausea. Her temperature, pulse, and urine were normal At first I endeavored to give her stomachic sedatives and regulate her food. In a few days she began to vomit and the vomitings gradually increased in frequency until all efforts at feeding by the mouth were abandoned and rectal enemata of milk and Mellin's food and brandy were used. She was fed exclusively by the rectum for three weeks, but still continued to vomit. The vomitus consisted of a thin mucus stained with bile. After vomiting a short time the patient began to complain of an intense burning along the entire œsophagus and great distress in the epigastrium. This burning was increased by the vomiting and seemed to occasion more suffering than the headache, which was almost constant. She could not bear the light of day and her room was kept dark. She exhibited no mental excitement but was ordinarily calm and obedient. Her abdomen was retracted during the entire attack. She never had any tympanites. Her skin, which at first was soft and velvety, became dry and parchment-like, and she emaciated to skin and bone. Pads were neccessary about her body to prevent bed-sores. She also complained of muscular soreness, especially about the neck, and the nurses were obliged to use great care in turning her. She was also tender to pressure over the abdomen. At times her urine was very scanty and was passed only once in the twenty-four hours. It was examined frequently and never contained albumin.

October 4. I began to give her subcutaneous injections of morphia which were continued until her stomach became quiet. As the vomiting diminished she was fed at first on rice-water and then on small quantities of more substantial food. She gained very slowly, and was not strong enough to be moved to her home until November 15th. At this time a porter took her in his arms and carried her to her compartment in a sleeping-car, as she was not yet able to stand upon her feet. During the ride to Philadelphia that night she began to vomit again, and I was told that the stomach was refractory for several days after reaching home. At present she is well enough to be about, but is not considered as strong as she was before her long illness.

CASE IV.—Miss D., forty-three years old, very dark complexion, black hair, sallow skin; white of eye clear, however. She has always been subject to bilious headaches. During the summer of 1888 she had an attack of vomiting, which made her very ill for several weeks and necessitated a number

of consultations. In the following September I saw her for the first time, and she was still feeling weak. A young niece in her charge was one day seized with convulsions, which were followed in due time by an eruption of measles. The aunt was, of course, anxious and worried about the child for a few days. As soon as the benignity of the measles was established the aunt went to bed. Her appetite left her and the old nausea come back. She did not vomit, but she ate very little for a few days in order to avoid vomiting.

I have had one or two other cases of this type of vomiting, but they presented practically the same features as those described above.

In Sajous' *Annual*, 1888, page 333, Dr. W. H. Thomson refers to two cases in his own practice which resemble my own. He says:

"In this connection the editor may mention two cases of vomiting of intensely acid matters in two female patients, each under thirty years of age, and which exceeded in severity any cases of vomiting that he had ever had to deal with. Both were of highly neurotic families, the first having an insane sister and a dipsomaniac brother; her mother died also in an epileptic fit. The second has a very extensive history of nervous diseases on her mother's side, including three cases of paralysis agitans, and one, an uncle, died of bulbar paralysis. The patient herself is greatly troubled with attacks of pruritus. After every other means recommended for the arrest of vomiting had been unavailingly tried in each case, they both had the affection completely checked by hypodermatic injections of morphia, which, however, had to be repeated in full doses; in one case for two days, in the other for five."

There are certain conclusions to be drawn from the above cases:

1. All the women whom I have treated for this type of vomiting have been of a *dark complexion;* some of them were pronounced brunettes. I have never had a patient of this class with red hair.

2. My patients have not been of the ordinary, so-called hysterical temperament. They were all calm and self-controlled, even during the severest suffering.

3. Feeding by the mouth was abandoned in every case, and rectal enemata were necessary.

4. None of the drugs which are usually potent in soothing a nauseated stomach were of any avail in these cases. They all seemed to increase the frequency of vomiting, because they necessitated giving something by the mouth. Morphine was the only drug which I have found to be of any service. This remedy I have given subcutaneously, and have regulated the size and frequency of the dose by the exigencies of the case. With patient No. II. the morphine nearly always caused vomiting within two minutes of its administration but no further

trouble. This drug not only controls the vomiting but it also abates the other discomforts. I do not know whether it shortens the illness or not. It has seemed to me that this class of cases run their course in spite of all medication until some hidden nervous impulse has exhausted itself. To illustrate, I would refer to a certain type of alcoholic impulse. Some men lead abstinent or temperate lives for months at a time, and then start off suddenly upon a prolonged drunk. They will drink until satiety is obtained, and then they become good citizens again until another alcoholic energy is generated. By conserving the strength, however, morphine may contribute materially toward recovery. Case IV. could not take morphine on account of its unpleasant effects, and no other drugs did any good, so she simply lay in bed and vomited until her nerve centres were satisfied. Her strength was sustained by nutritive enemata.

5. The vomitus of Cases II. and III. was very acid, and caused great discomfort along the throat, and particularly beneath the sternum. In Case I. the tongue became excoriated and painful, and at one time one side of it was so swollen that the mouth could only be closed with difficulty.

In connection with this hyperacidity it will be interesting to note certain cases of acid vomiting described by Rossbach,[1] and designated *nervöse gastroxynsis.*[2] This trouble affects the upper classes and persons exposed to great mental strain. It comes on in attacks of one to three days' duration, which may be repeated weekly or every month or so. Anger, trouble, excitement, or public speaking may explode an attack. Each invasion begins with a headache, or with a sharp, gnawing sensation in the stomach, which is then followed by headache; the latter becomes very intense during the height of the attack. The acid feeling in the stomach increases, and may be sufficient to prevent sleep. The patient looks pale, and shows intense suffering. There is pain and sinking-in of the eyes. Finally, the vomiting of an intensely acid fluid begins, which irritates the mucous membrane so that the entire throat feels raw in a few hours. Rossbach says that pyrosis has never occurred in any of his cases, and he emphasizes this fact as a differential point in distinguishing gastroxynsis from dyspepsia acida and Reichmann's cases of excessive gastric secretion.

[1] Rossbach: Deutsch. Arch. für klin. Med., 1884, 35.

[2] γαστὴρ—stomach; ὀξὺς—acid.

Rossbach says the best treatment for this trouble is to wash out the stomach thoroughly with warm water. As soon as the acid contents are removed the headache, etc., subside, and the sufferer rapidly returns to his normal condition. If the attack has been progressing for some time, and a large quantity of acid has been poured into the stomach before the lavage is begun, then the recovery is not so rapid, but the washing produces amelioration. If the patient is vomiting vigorously, there should be given him a half-pint of warm water to drink after each act of vomiting, and repeat this until relief is obtained.

The acidity of these cases depends upon the excessive secretion of hydrochloric acid, and is independent of the presence of food in the stomach. It should be distinguished, therefore, from the ordinary *dyspepsia acida*, which is a condition produced by an abnormal fermentation of the food, and in which the acid is butyric, lactic, or acetic, according to the ingredients of the food.

It is needless to add that the Rossbach type of gastroxynsis is often a symptom of tabes, and may even precede the appearance of other symptoms. Thus Spier and Clark[1] report the case of a young gentleman who "suffered from intermittent attacks of uncontrollable, very acid vomiting, which would sometimes last for weeks, and yet the usual signs of gastritis were not present." The suspicion that his vomiting might be due to tabes was confirmed by the subsequent development of the characteristic lancinating pains and motor disorders. The etiological values, therefore, must be carefully estimated in each case before it can be classified as a pure neurosis.

There is another condition of the stomach which requires mention at this point, and that is gastrosuccorrhea or the hypersecretion of gastric juice, which was first described by Reichmann.[2] The first case observed by him was a man, twenty-seven years of age, who was very anæmic, emaciated, and weak, but he had no organic disease of the nervous system. Every afternoon he was seized with severe cramp-like pains in the stomach, which increased during the night, and spread over the entire abdomen. The cramps prevented sleep, and caused an expression of great suffering on the face. There was no distention of the abdomen, no belching, and *no vomiting*, but the patient was troubled with pyrosis, great thirst, and an increased appe-

[1] Sajous's Annual, 1888, p. 33.

[2] Reichmann: Berl. klin. Wochenschrift, 1882, No. 40, and 1884, No. 2.

tite. Upon washing out this man's stomach Reichmann always found a large amount of very acid secretion, whether the stomach was empty or full of food. To test the amount of the fluid thus secreted, Reichmann pumped out the man's stomach late in the evening, and washed it clear of everything; then the man took no food or fluid into the stomach until the next morning, when the washing-out was repeated. This experiment was tried four times, and on each morning the stomach contained from 180 to 300 cubic centimetres of a fluid which was very acid, more or less green, and nearly translucent. This fluid was evidently rich in pepsin, as it digested albuminoid matters very rapidly, but the amyloid foods remained undigested. After a breakfast consisting of one cutlet, 250 grammes of milk, and 250 grammes of water, the stomach was pumped out in the third hour, and contained one and a half litres of a dirty-looking fluid, which had an acidity of 0.28 per cent. After an ordinary mixed meal the evacuated contents of the stomach presented a very characteristic macroscopic appearance. The albuminoid ingredients had all been dissolved, while the mass was full of large starch remains, pieces of bread, etc. Riegel[1] says:

"I must emphatically recommend the simple observance of the pumped-out mass, and especially of the filtrate, the importance of which has never before been pointed out. The appearance of the mass will often, without further chemical examination, furnish conclusions as to the digestive power and nature of the secretory disturbance."

This type of hypersecretion of the stomach occurs in two forms: in some patients it comes on periodically, and is then usually associated with some nervous diseases; in other persons the condition is chronic. Jaworski[2] has collected 48 cases of this chronic type in 222 gastric patients, while Ewald has met it 15 times among 600 gastric cases. The best treatment for this complaint is daily lavage, which is usually very gratefully appreciated by the patient.

In studying this subject I have discovered that there is one factor which is common to all the cases described in this paper, and which is the keystone to all the suffering and misery which befall the poor victims of these functional derangements. We notice, namely, that the description of each case of vomitus nervosus, gastroxynsis, and

[1] Riegel: Zeitschrift f. klin. Med, 1886, p. 1.
[2] Jaworski: Wien. med. Wochenschrift, 1886, p 1673.

gastrosuccorrhea is accentuated by the excessive amounts of hydrochloric acid present in the gastric secretions.

The standard acidity of healthy gastric juice is placed at 0.2 per cent., though it may vary five-hundredths of one per cent. each side of this without harm. Rossbach, however, reports one case in which the acidity was 0.416 per cent., and in two others it was 0.334 per cent. In Reichmann's cases the acidity was 0.25 per cent., 0.27 per cent., 0.28 per cent., and 0.32 per cent. In my own cases no estimate of percentage was made, but the acidity was so great that it caused intense burning of the œsophagus, fauces, and tongue, and this burning was often the chief complaint of the patient. In my first case of anorexia nervosa I have been unable to obtain any gastric secretion; but, inasmuch as the tongue was extremely clean and red, and the patient complained of canker, I suspect the gastric acidity must have been above the normal standard.

Leube made no mention of this point in connection with his cases of dyspepsia nervosa, but this deficiency of evidence has been recently supplied by Wiessner,[1] who made a special study of nervous dyspepsia in the wards and laboratory of Prof. Leyden. He found that all such cases presented high degrees of acidity. He reports instances of 0.29 per cent., 0.40 per cent., and 0.312 per cent., and he concludes his thesis as follows:

"In *nervöse dyspepsie* the motory function of the stomach is intact. The secretory function is abnormal to the extent that a notable HCl hyperacidity is demonstrable during the entire process of digestion."

Jaworski,[2] in an article upon gastric symptoms *vs.* objective findings, gives his deductions from the examination of several hundred stomachs in health and disease, and he has evidently reached conclusions similar to mine concerning the influence of hyperacidity in gastric troubles. He lays down the following suggestions:

1. In great anæmia, and even cachexia with idiopathic gastric trouble, there is a probability of a hyperacidity of the gastric juice.

2. Vomiting usually occurs with those who have no deficiency of hydrochloric acid.

[1] Wiessner: Diagnostische und therap. untersuch. u. d. nervöse Dyspepsie. Inaugural Dissertation. Berlin, 1888.

[2] Jaworski, as above.

3. With great sensitiveness of the epigastrium to pressure, deficiency of hydrochloric acid is not probable.

4. Excessive thirst points to hyperacid secretions, and is generally combined with mechanical insufficiency or gastric ectasy.

5. Cramps indicate acidity.

6. Gnawing at the stomach and false appetite denote acidity.

Arrived at this point, we are met with great difficulties in our study of the physiological mechanism of these cases. We know practically nothing about the specialization of the nerve supply to the stomach. Schiff thinks that sensory nerves run to the stomach through the vagi, because if these trunks are cut one can abuse the pylorus, which is ordinarily the most sensitive part, without the animal showing pain. It is also possible that sympathetic branches from the cœliac plexus also convey sensory fibres to the stomach. We know, however, that the stomach is sparingly endowed with sensory nerves. Its temperature perception is imperfect and localization is very indefinite. If a sound is introduced it is felt in the œsophagus along the thorax, but is hardly perceived when it touches the inner surface of the stomach. The organ may even be mutilated without much discomfort to its possessor. A case is reported where a piece of the mucous membrane was caught in the eye of the pump and was brought away, but the patient only felt a sense of pulling; the pain was unimportant, and ceased in a few hours. Oser[1] says, "The healthy stomach has properly only two perceptions: the feeling of hunger and the feeling of satiety." Pathologically the sensitiveness of the stomach may be intensely aggravated. What nerves stimulate and what ones inhibit the secretion of the hydrochloric acid, pepsin, mucus, etc., is simply a conjecture. No more do we know the special nerves which govern the rhythmical sequence of the muscular churning, or which dilate the pylorus, or hold it in cramp-like closure. Some physiologists have thought that they could stop all gastric secretions by section of the vagi, but later observations have demonstrated that such section may produce a temporary slowing of the secretion of pepsin and hydrochloric acid, but not an obliteration of the same.

We can only say from our present standpoint and by reasoning from analogy, that the secretion of hydrochloric acid in the stomach

[1] Oser: Die Neurösen das Magens, 1885.

must be governed by a special system of nerves which have a definite centre of departure. Like other similar systems, these nerves appear at times to become functionally deranged, and perform their work with a reckless disregard of the comfort of their possessors.

DISCUSSION.

DR. S. WEIR MITCHELL: I have only a few remarks to make, but I may say this, in regard to all cases of neurasthenia in which there are great complaints of gastric and intestinal difficulty, that one has constantly to consider the possible presence of hypochondriacal conditions which dominate a great many of these cases, and makes one look with a good deal of doubt upon the statements of these persons with reference to pain, distress, etc. The gastric integrity of cases such as these is taken for granted on reasonably good evidence; that is to say, the perfect digestion of food complete within the normal time, which is said to be the seventh hour. By this time a certain proportion of the gastric fluids must have passed into the intestinal canal, and intestinal digestion begun.

Some of the symptoms referred to may be due not merely to gastric conditions, but to states of the intestine below the stomach. We have here as symptoms headache, dizziness, palpitation of heart, and strong pulsation of the abdominal aorta. These are neurotic. Then come, locally, pressure feelings, tenderness of the epigastrium, pyrosis, vomiting, nausea, hiccough, yawning, and alterations of taste. I think that few cases of grave neurasthenia present themselves without some of these. I have observed, also, that the set of symptoms in which the head is involved come on often the moment after food is taken, and before the abdominal symptoms make their appearance.

It is stated in the essay just read that all of the discomforts felt come on immediately after eating, and it has been supposed that they are due to direct mechanical irritation of over-sensitive nerves. I do not know whether that means irritation of the gastric surface nerves or whether it refers to irritation of the whole nervous system connected with gastro-intestinal digestion. I do know, however, in regard to a great many functions which are performed with absolutely normal correctness, and where the organs concerned are not at all diseased, that in neurasthenic people the general irritability of the central nervous organs causes these functions to be productive of symptoms. For example, we meet with patients who faint when the bowels are moved. I have known of several cases, women especially, who become faint, and one who becomes excessively dizzy whenever micturition is performed. These remarks apply to a large range of functional activities where the organs concerned are apparently normal, the condition of the body being one of irrita-

bility. We certainly find this in connection with the stomach. You may have a perfectly normal stomach, with normal digestion and secretion, with the motor functions of the stomach well performed, and yet the functional activity of such an organ may be productive of a series of phenomena chiefly referred to the nervous system. I scarcely know whether or not this is simply another way of saying that these are due to direct irritation of over-sensitive gastric surface nerves. It seems that this is going a step farther.

In regard to anorexia nervosa, Matthews Duncan says that it is a ghastly spectacle, that people always recover, that it may occur in men, but he never saw a case, etc. He and others distinctly say that it is not hysterical. It seems to me that the occurrence of these cases without at least a background of hysteria is very rare. It is suspicious that they never occur in men. I fancy that if the authors who hold his belief had had a great experience with hysteria they would have found in the background some signs of this mysterious condition. I am perfectly certain that in some of the cases I have seen anything like gavage would have been impossible. In a bad case of anorexia nervosa, especially where there is a distinct hysterical element, the attempt at gavage often brings on violent convulsions. I have tried this over and over, and I have rarely succeeded with forced feeding. I am also certain that you will fail in trying to treat these cases by the rectum; violent tenesmus follows and the food is ejected, while if the attempt is persisted in violent convulsions may follow.

Finally, as regards cyclical emesis, one must be on guard as to its being a symptom of tabes dorsalis. I have seen several cases in which gastric crises anticipated by long periods the motor disorders which in the end competently explained their presence.

Dr. William Pepper: I should like first to say a word in regard to vomitus nervosus. I should be glad to have Dr. Garland tell us in what respect, other than in the invariable extreme acidity of the matters ejected, these cases differ from the cases that have been carefully described under the terms cyclic vomiting and recurrent vomiting. I have for many years been familiar with these cases. I have seen cases precisely like the fatal case narrated. One that comes to my mind most clearly, was that of a young married woman, who had never borne a child, and who had had no illness until the age of twenty-four or twenty-five years. Following extreme exhaustion in nursing a relative, she was taken with an attack of vomiting which lasted eight days. She got better, and went some time without an attack. Then, after being fatigued by a long journey, she had another attack, lasting eleven days. This was the first time that I saw her. There were no evidences of hysteria. It was impossible to get the stomach to retain anything. The system was kept under the influence of morphia hypodermatically, and feeding by the rectum was employed. She finally recovered. A third attack occurred, lasting fourteen days. The most careful examination of the eye-ground was made by Dr. Shakespeare. The urine was examined by several experts, every organ was studied, a gynecologist examined the pelvic organs—all with negative

results. Once or twice the attacks occurred as the menstrual period approached, and seemed to cause postponement of the flow, which did not appear until the vomiting subsided. But it was clear there was no real connection between them. A fourth attack came on, and at the end of fourteen days she fell into a comatose state, with turbid ammoniacal urine, twitching of the muscles, and finally death. A thorough post-mortem examination yielded absolutely negative results. The question arose, whether the fatal issue could be due to the morphia, but the drug had been stopped for some hours before the approach of the stupor, and she had been treated in precisely the same way before. It seemed as though there must have been some poisonous agent produced by disturbance of the coördinated functions of the liver, stomach, etc., so that it appeared to me to be an intense degree of what we know as cyclic vomiting.

I have seen typical attacks in children five years of age, recurring at short intervals until the age of fifteen. I have seen them in middle life. I have just seen recovery in a lady who is now seventy-two years of age, and who suffered for thirteen years. The original attack was apparently induced by a nervous shock, and thenceforward with increasing frequency and facility severe attacks were induced. At first they occurred at intervals of a few months, later at intervals of a few weeks. There was gradual loss of flesh, and the patient became very weak, and so morbidly sensitive that any exposure or excitement or fatigue would certainly produce a violent spell. Finally, she was confined to her chamber for many months, having spells at intervals of about ten days. The attacks would begin with low spirits and irritability, usually coming on toward evening. She would then be awakened toward morning, sometimes with headache and sometimes with abdominal pain, but always with intense nausea. Intractable vomiting then set in, and continued for twenty-four, forty-eight, or even seventy-two hours, during which time no food and no remedy would be tolerated. It seemed best to let the stomach alone until the nervous storm that overwhelmed the centres coördinating digestion had expended itself. I had the matters discharged tested, in the hope of finding some leucomaine which might throw light upon the cause, but without any definite result. I cannot help believing that we shall, however, make important discoveries in this direction.

In the attacks of this patient, as well as in others I have seen, the matters vomited were first altered food, if the stomach were not empty, then a clear mucus, sometimes intensely acid, and later bile-stained mucus, or almost pure bile. Sometimes, however, the ejecta were not intensely acid. As bearing upon the part played by the liver, I would add that in the case detailed above, and in many others, I have noted that the feces were almost white for weeks or months, and that while this absence of bile continued, the tendency to recurrence of attacks remained marked. At the time of the attack all remedies administered by the mouth failed to give relief. Hypodermatic injections of morphia or opium by the rectum, allayed distress and controlled vomiting, but their use often seems followed by weakness, impaired

digestion, and troublesome constipation. In bad cases it is a choice of evils, and an opiate may seem necessary.

One remedy from which I have thought I obtained benefit, is antipyrin. In two or three cases it has apparently stopped the attacks. One was a lady, fifty-five years of age, extremely sensitive, who fell into this condition following the illness of three members of her family, which devolved much care and anxiety upon her. She had a number of spells of the type described. Finally, antipyrin in doses of five grains was used, and apparently with positive effects, as, although she has been threatened a number of times, the administration of this drug has always averted a severe attack. The condition of anæmia and debility which results when frequent attacks like this have occurred, is extreme. I have found that frequent and prolonged changes of climate, by favoring recuperation of general health, exert a most favorable influence upon the tendency to recurrence of the spells.

It does not seem to me that the mere fact of excessive acidity of the ejecta calls for a different nomenclature. I am disposed to think that all such cases come under the head of cyclic vomiting, and that the pathology is, as suggested a depressed state of the nervous centre controlling the coördinated functions of the stomach and liver; extreme mobility and sensibility of system; and then from various slight causes, recurring disarrangement of digestion, with production of further debility, and of some irritating leucomaines, which arouse the violent gastric disorder.

Dr. Francis P. Kinnicutt: I would ask whether a qualitative analysis was made of the matters vomited in the cases reported by Dr. Garland? Was the pyrosis a hydrochloric acid pyrosis, or the pyrosis due to the presence of fermentative acids, lactic, butyric, acetic, etc.? It seems to me important to differentiate between lactic acid and hydrochloric acid pyrosis. This might throw some light upon the etiology of these cases. An intensely acid pyrosis is often due simply to the presence of acids of fermentation.

Dr. G. M. Garland: In regard to the nature of the acid. In one case the patient took absolutely nothing by the mouth for three weeks, and therefore the acids of fermentation would be eliminated. In the other case, the patient did not take food into the stomach for days at a time.

In all of my cases, the head symptoms seemed to precede the vomiting and other symptoms. The headache was followed in the course of twenty-four or thirty-six hours by the vomiting.

In regard to Leube's assumption of irritation of the gastric nerves, that was his first theory. He assumed that it was a local neurosis. That was a strongly contested point by subsequent investigators. Finally, Leube came to the conclusion that this was only one expression of a general condition; that the irritability of the gastric nerves was simply one feature in the condition of general neurasthenia.

With regard to cyclic vomiting. Case I. is evidently an example of cyclic vomiting. The patient had a history of cyclic vomiting going back to an

early age. Case II. had no history of dyspeptic symptoms until a year ago last April, she then began to decline in health, and vomiting began in September. This could hardly be termed a cyclic case. This was a case of hyperacidity of the stomach.

I have seen a number of cases of cyclic vomiting associated with menstruation. I have in mind a woman who vomits at each menstrual period. The matters vomited, however, are never acid. She vomits an immense quantity of mucus stained with bile. The vomiting usually continues for twenty-four hours. I have had this summer two other cases of sweet vomiting. One was a young woman married last winter. She became pregnant, and vomiting began. She miscarried at the end of a few weeks, but vomiting continued. She finally developed head symptoms and became stupid and died. There was no autopsy. The fluid vomited was not acid; it was almost neutral. The second case was that of a woman who vomited for several weeks an almost neutral fluid. In this case the spleen was enlarged. These two cases were not included in the paper.

Antipyrin was tried in one of these cases, but failed to restore the equilibrium of the stomach, although it relieved the headache.

I do not think that these cases can be classed under the head of cyclic vomiting because some of them had never vomited before. My object has been simply to call attention to the fact that we have certain cases of this terrific vomiting associated with a perversion of the secretion of hydrochloric acid in the stomach. The question came up in my mind, Have we here one expression of perverted nerve action which prolongs this vomiting, assuming the vomiting is due to the general nervous condition?

DR. G. BAUMGARTEN: It may be of interest to add to the cases collected by the reader the account of another case which has not been published. I had the opportunity of seeing, in the last days of her life, an old lady who died with persistent icterus, terminating in marasmus. The patient presented no other symptoms than those referable to the icterus. At the autopsy nothing was found except a scirrhous tumor about the size of a hazel-nut at the mouth of the common duct. There were no secondary growths. The common duct passed through the tumor, but was so completely obstructed that no bile passed it during life.

THE CONTAGIUM OF DIPHTHERIA.

By P. GERVAIS ROBINSON, M.D.,
of St. Louis, Mo.

I propose to occupy the time allotted to me with some observations upon the contagium of diphtheria; not because I lay claim to any special knowledge upon the subject, nor because I have anything either particularly new or original to say; but for the reason that there still prevails so little harmony of views as regards either the pathology, the etiology, or therapeutics of this dread disease.

In the last generation only have we become at all familiar with the clinical features of this "fearful malady," because, though of remotest origin, it has prevailed chiefly in European and Asiatic countries until toward the latter part of the last century; and until within twenty-five or thirty years its recurrence on this continent has been so infrequent and at such long intervals that but little impression of its potency for destruction has been made upon the professional or public mind.

During the last ten or fifteen years the number of its victims has been steadily growing larger and the area of its influence has so extended, that to-day it prevails over the greater portion of our country. At no time can we now be said to be free from its presence, while here and there at stated periods it rises into epidemic fury, through the exciting influences, perhaps, of local causes as yet but illy defined or even quite unknown. While, as in other infectious diseases, diphtheria sometimes occurs in so mild a form as to excite a question of diagnosis; as a rule, the mortality is high, reaching 30 or 40 per cent. of cases reported, and not unfrequently its destructiveness is appalling, being second in this respect to the plague alone. Whole families and households are occasionally swept away within a few days, nurses and physicians as well falling victims to its virulence. Quoting from the statistics of diphtheria for the years 1886, 1887, and 1888

in St. Louis, kindly furnished me by Charles W. Francis of the Health Department, we find the following interesting figures, which give us an estimate of the mortality as nearly correct as we are likely to get it. That municipal law which compels, under penalty, the report of every case of diphtheria and the posting of the house in which it occurs, I believe is very generally observed, and hence we are liable to have, through errors of diagnosis, a certain proportion of cases reported which are not instances of this disease. In estimating the mortality we must take into consideration this probable source of error, which may be considered as a universal one and one not to be avoided, especially during a general or epidemic prevalence of the disease.

In St. Louis, for the year 1886, there were reported 2826 cases: 719 deaths.

For the year 1887, 3108 cases: 927 deaths.

For the year 1888, 1658 cases: 564 deaths.

Total for 3 years, 7592 cases: 2210 deaths; giving a mortality of 30.10 per cent.

For 19 weeks during this year, 1889, there were reported in New York City:

Total cases, 3163: deaths 922; being a percentage of 29.1

The mortality for Boston is reported for 1887 as 30.03 per cent., for 1888 as 33.12 per cent.

Of cases reported, however, as being diphtheria, I believe we may with confidence eliminate a certain number which should more correctly be classed under some other form of throat affection, as some variety of tonsillitis, perhaps. So that we can safely consider that 35 per cent. more nearly represents the actual mortality. Compared with this fearful death-rate, we find the mortality of scarlet fever, so justly dreaded, as only 11.4 per cent.

To determine the actual number of deaths occurring annually throughout the whole country is impracticable from the fact that in many of our smaller towns and in country districts where diphtheria often prevails in a severe form, no vital statistics are kept and no returns of death from whatever cause are made. We may approximate, however, a just estimate of the total mortality from this disease by taking into account the published records of several of the larger cities of the country whose statistics have some claim to our confidence.

Here we have reported for one year, say 1881, from the following cities:

	Deaths.	Population.
New York	2,249	1,242,523
Brooklyn	1,169	583,221
Baltimore	881	339,809
Chicago	609	540,000
Boston	601	397,628
Philadelphia	457	940,000
San Francisco	287	230,000
Cincinnati	183	264,139
St. Louis	157	380,000
New Orleans	91	225,000
Charleston	15	50,000
	6,699	5,192,320

In a total population of nearly five and a quarter millions of people we have then six thousand seven hundred deaths from this one cause, we may say in the ratio of 1.29 per thousand. Putting the population of the United States at 60,000,000, with the presumed general prevalence of the disease, we must conclude that very nearly, if not quite, sixty thousand victims perish annually from the ravages of this malignant disorder.

However incomplete may be our vital statistics, and though replete with errors which come from a variety of circumstances hardly to be avoided, such as they are, they nevertheless give us an insight into the magnitude of this cause of mortality, now constantly prevailing in almost every section of our land, affecting mainly those yet in the springtime of life, the most healthy and robust of our children equally with those more tender and apparently predisposed to sickness and premature death.

In pursuing our studies of the contagium of diphtheria several questions present themselves, upon whose solution depends the initiation of means and measures for its prevention and cure, and these shall be more or less appropriate and effective according to the nature of the answers to the questions propounded.

In regard to some other infectious diseases, notably variola and typhoid fever, we have acquired by long and oft-repeated observation much correct information and many well-established facts, and we are agreed both as to those conditions favorable to the development and

propagation of these diseases and in accord as to those measures best calculated to arrest their progress. Not so in diphtheria; it is difficult to find any two who entertain identical views either as to the nature of the materies morbi, the etiology or its therapeutics, and when we look into the literature of the subject we are struck with the great diversity of opinion expressed as to these all-important questions.

The first and not the least important question is that which refers to the nature of the contagium; what, in other words, constitutes the materies morbi of diphtheria. We know it to be an acute infectious disease; no point in its history is better established than this; clinical experience has long since satisfactorily proved that fact. The presumption, based upon the known characteristics of the contagium of some other infectious diseases is so greatly in favor of the microbic nature of diphtheria that we are readily converted to that belief, notwithstanding the still prevailing want of agreement in the researches of even the most skilled and experienced investigators.

Researches in regard to tuberculous diseases have been so successful, have led to such satisfactory results, pathologically at least, that views formerly held in regard to this class of affections have been completely revolutionized; the tubercle bacillus is an established fact.

There must be a corresponding change of front in our defence against the invasion of this minute, yet potent, enemy of the human race, and in like manner must there be a modification of the therapeutics of tuberculous affections as well as of the treatment of those morbid changes which are but the secondary results of the action of the germ upon the several organs and tissues of the body for which it manifests a special predilection.

This advance in the knowledge of the pathological cause of tuberculosis encourages us with the hope and expectation of a like success and equally satisfactory results in the search for, and identification of, the proper germ of diphtheria. Notwithstanding the claims that have so far been made for the discovery of the microörganism producing this affection, the apparent absence of uniformity in the results of experiments instituted by numerous investigators to establish its identity and the disagreement as to the reported effects of inoculation upon several of the lower animals leave us in doubt as to the justness of any one so far advanced. The idea that diphtheria is a parasitic disease is of no recent origin and is said to have been entertained as

far back as 1858[1] or 1859. Early in the research a source of confusion was found in the multitude of bacteria to be seen at all times in the secretions of the mouth and throat, in a healthy as well as diseased condition, so that the first step in the investigation was to separate the harmless from the morbid organisms or such as under certain conditions are to be regarded as pathogenic. The well-established contagiousness of this dread malady and its ready inoculability upon the human system have doubtless limited the number of workers in this field of research and retarded conclusions that but for this obstacle might long since have been attained. We cannot but admire the courage of those who, fearless of this admitted danger, prosecute researches which can bring reward, not through individual benefit, pecuniary or other, but through the consciousness of incalculable good to their fellow-men.

In this way it was that Klebs had the deplorable misfortune to convey the infection to his own family, resulting in the death of two of his children. In like manner, and but very recently, Dr. Nelson, of Boston, during his researches on the contagium of diphtheria and "after no other exposure" suffered a severe attack of the disease with full development of both local and constitutional symptoms.

To rehearse the accounts of the numerous researches which have been made in this direction, would be a work of supererogation and a gratuitous waste of time when all are familiar with the literature of the subject, but I may be permitted to make reference only to those most recent experiments which appear to promise a solution of this important question as to the identity of the diphtheritic microbe.

Until recently we have felt a certain degree of confidence in the claims of Klebs and Löffler as to the identity of the bacillus, apparently demonstrated by them to be the organism constantly present in the localized lesions of diphtheria; yet their researches were far from conclusive, since another species of bacterium, a micrococcus, was often found in connection with the bacillus, so that both of these observers were led to believe that diphtheria might be produced by more than one species of microbe. Recently Roux and Yersin claim to have discovered the same form of bacterium, the bacillus of Klebs, in all the cases of diphtheria (fifteen) examined by them morphologically,

[1] Laycock: Medical Times and Gazette, May 29, 1858.

and in a certain number (not stated precisely) by the culture method, and that by inoculation upon rabbits, guinea-pigs, and pigeons they produced not only the local manifestations of diphtheria (false membrane), but further (this the most important result) succeeded in producing, by injections of the filtered culture liquid, the characteristic secondary manifestations of the disease, various paralytic phenomena.

The symptoms and lesions are said to differ somewhat according to the seat of inoculation and the material inoculated, whether with the microbes or with the culture fluid freed by filtration from bacteria. While both are toxic in their effects and while the symptoms and post-mortem appearances are identical when either is used for inoculation, membranous formations only follow the introduction of the bacillus; different degrees of diphtheritic intoxication were produced according to the dose of filtered liquid administered, varying from those cases which were curable to those in which paralysis occurred or in which death took place in a few hours.

In a general way these observations accord with those of Löffler and Klebs and are confirmatory as to the identity of the pathogenic microbe of diphtheria. The most important observations recorded by them are those which relate to the production of paralysis by the introduction of the poison generated (supposedly) by the bacteria into the blood of various animals. Yet my confidence in the reported observations and experiments of Roux and Yersin has been much skaken by the criticism of our friend Dr. Prudden, who, in his recent and most valuable article on diphtheria, says, "The records are so incomplete and their technical procedures are of such a questionable nature and are so meagrely described that it is very difficult to conclude whether the work is important or not."

In a recent paper on the etiology of diphtheria, Dr. Samuel N. Nelson, of Boston, refers to his own researches and claims to have found abundant micrococci in bulb cultures made from the false membrane of a patient operated upon by Dr. H. O. Marcy. Four guinea-pigs were inoculated in the cornea with the contents of one of the bulbs containing the culture of the sixth generation. One of these animals died thirty-six hours later of blood-poisoning. The others became very ill, losing their appetite and the eyelids becoming much swollen and œdematous with profuse discharge which contained micrococci. The cornea became cloudy and was covered with a membrane.

Two of these animals were killed on the third day after inoculation, this being the period at which the micrococci developed; one was allowed to get well, but the eyes were completely destroyed. Micrococci were found in the aqueous humor of the dissected eyes as also in sections of the cornea of the eyes which had been placed in alcohol immediately after removal, and when hardened were cut with a microtome.

These experiments are confirmatory of other observations which go to show that there is a microbe, or perhaps several, closely associated with diphtheria which can be cultivated, and which when inoculated in several animals produces more or less constitutional disturbance, sometimes with fatal results with certain local changes at the point of inoculation, resembling more or less closely the false membrane of diphtheria. The most important link in the chain of experience recorded by Dr. Nelson is the fact of his having contracted the disease in a severe form while making these researches and, as he declares, "after no other exposure."

Truly, we have, in his own language a remarkable sequence of events:

"1. A typical case of diphtheria.

"2. The presence of micrococci in the membrane.

"3. The cultivation of the micrococci in pure culture to the tenth generation.

"4. The inoculation of guinea-pigs with micrococci of the sixth cultivated generation and reproduction of the disease.

"5. The unwitting inoculation of the experimenter, thus bringing the disease back to its original form in the human being."

Altogether, the most valuable contribution to this subject is that recently made by Dr. Prudden. We are inspired with confidence in his conclusions, from his well-known skill and painstaking care to avoid all imaginable sources of error in his pathological investigations. Every one here present is doubtless acquainted with the details of his experimental researches, lately published in the *American Journal of the Medical Sciences.* Yet I may be permitted to quote, and in his own words, the summary of his work.

"We have found, by a critical examination of the studies which have heretofore been made on diphtheria by the use of the modern methods of research,

that no definite species of bacteria has been discovered which could fairly be positively regarded as the cause of the disease.

"We have studied in detail, both by morphological and biological methods, twenty-four cases of diphtheria in young children, most of them occurring in hospitals, in which the affection has assumed the character of an epidemic, the disease either occurring by itself or in connection with suppurative diseases, or scarlatina or measles. In all but two of these twenty-four cases we have demonstrated the presence of a streptococcus, usually in large numbers in the local lesions, and in small numbers, in a few of the cases, in the viscera.

"We have established by the biological methods the specific characters of this streptococcus, and by animal inoculations in rabbits and pigeons have found that it is markedly pathogenic, inducing erysipelatous or phlegmonous inflammation, abscess, and localized necrosis. We have not succeeded in inducing on the mucous membranes of animals any lesions which could be fairly regarded as similar to the local lesions of diphtheria, as these are ordinarily developed in man. We have found, however, that diphtheria as we see it in man does not apparently occur spontaneously in animals, and has not been induced experimentally by any of the numerous and variously modified inoculations thus far practised.

"We have in control examinations of mouth and tonsil scrapings from thirty-one healthy and sick children, not apparently exposed to diphtheria, never found the streptococcus, except in two cases of scarlatina in which diphtheria soon after developed. On the other hand, in examining throat and tonsil scrapings from forty children exposed to the disease in a hospital in which it was epidemic, we have found the streptococcus in twelve of them. In two of these fatal diphtheria soon followed; once we have found it floating in the dust of the room in which the disease had originated. We have seen that all of these observations, taken together, seem to lead us to so strong a presumption that the streptococcus is the causative factor, in this group of cases at least, of diphtheria, that it practically amounts to a demonstration.

"We have found reason for believing, on biological and experimental grounds, that the streptococcus occurring so constantly in these cases of diphtheria is probably identical with the streptococcus pyogenes and streptococcus erysipelatosus. It has been shown that the apparent identity of the inciting species of bacteria in erysipelas, in some forms of phlegmonous inflammation and in at least certain groups of cases of diphtheria, is not only not inconsistent with our knowledge of the pathology and symptoms of these three forms of inflammation, but serves to account for various facts concerning the nature and spread of diphtheria which have hitherto seemed obscure.

"We have found that the crypts of the tonsils form a favorite nesting-place for the streptococcus, and that it may lie harmlessly there, even in considerable numbers, unless some lesion of the mucous membrane provides conditions suitable for its growth, when it may enter upon a career of active, and, as it would seem, fateful, proliferation. In the presence of the streptococcus

in large numbers in the local lesions of diphtheria, and in its absence in any considerable numbers, as a rule, in the internal organs, we find ground for the belief that the symptoms of systemic infection are probably in large measure due to the absorption of a soluble poison produced by the bacteria at the seat of their most active proliferation.

"We have demonstrated that the streptococcus of diphtheria is not readily destroyed by drying, but, both in the form of pure cultures on threads and fabrics, and in the pseudo-membranes itself, may retain its vitality for long periods when dried in the air. We have tested its vulnerability when brought in contact with some of the commonly used antiseptic agents, and found, first, that the vapor of burning sulphur is very inefficient and unreliable in destroying the germs.

"We have found that carbolic acid and creolin in considerable strength destroy the streptococci, but in dilute solutions are inefficient; while sublimate, even in very dilute solutions, heads the list in its killing power. But we have also found, as was to be expected, that all of these germicides are much less efficient when applied to the bacteria which lie embedded in the pseudo-membrane and in the tissues, than when they are free in the pure cultures."

The result of these many researches is to lead us to the conclusion that the contagium of diphtheria is a living germ or microscopic organism whose identity may yet be considered as unsettled; whether a bacillus or micrococcus is so far uncertain. Perhaps it is, that either of these may be the active agent in the causation of the disease, since both have been found to be present by different observers in most cases examined; both have been cultivated, both have been inoculated upon the systems of lower animals, both have been shown to produce toxic effects, and, as claimed by some experimenters, to lead to the formation of false membranes, to the secondary constitutional disturbances characteristic of the disease, and, by two observers at least, to the subsequent paralytic phenomena which constitute the most remarkable sequel of diphtheria.

Not only is it of scientific interest to establish the identity of this germ, but of the utmost importance in a practical point of view. Since, with the identity established, its habitat and life-history may be studied, those conditions determined which are favorable to its vitality and propagation, leading, finally, by experimentation, to a successful prophylaxis, either, on the one hand, by the establishment of such sanitary precautions as shall destroy the conditions necessary for the conservation and diffusion of the organism, or, on the other,

by the direct application to the vulnerable mucous membrane of those obnoxious, of such agents as may be found so to change the condition of these parts as to remove their vulnerability, or even to destroy directly the vitality of the bacteria which may have effected a lodgement.

We may next inquire as to the manner in which the system becomes infected? What is the avenue of invasion? Whether the "materies morbi" which induces the local manifestations of diphtheria reaches the part locally affected, through the blood current, or is it always brought directly into contact with the part affected?

There is no question concerning diphtheria upon which there is less agreement than this, and of its great importance there can be but one opinion, since its decision must furnish a guide not only for the treatment but for the prophylaxis as well. Those who entertain the view that diphtheria is primarily a general or constitutional malady, and that the membranous formation is secondary and constitutes the characteristic anatomical lesion, base this opinion chiefly upon the apparent analogy between this and certain other acute infectious diseases in which this relation of the general and constitutional state to a constant anatomical lesion has been established. These assume that the morbific agent conveyed through the medium of the surrounding atmosphere reaches the delicate mucous membrane of the respiratory tract, or in food and drink the digestive organs, where, by the process of absorption at either point of contact, it is taken into the current of the blood, there to enter upon its dread career.

Constant failure to arrest the progress of the disease, or to produce any impression whatever by a variety of topical applications, would seem to favor this view. Such failures to us are satisfactorily explained by those recent researches which demonstrate the tenacity of life possessed by the contagium vivum and its resistance to the best of so-called antiseptics in daily use. The active and multiplying bacteria lie imbedded beneath the accompanying new formations, and to a great extent protected against the effective action of topical applications.

I am myself confirmed in the belief that diphtheria is primarily a local disease, and that the general system becomes affected, in all cases where constitutional symptoms occur, by absorption of poisonous material, whatever may be its nature, generated at the seat of the local

lesion, the point of inoculation we may say properly, since inoculation it always is in truth.

The most convincing evidence in favor of this view is to be found in those cases of accidental inoculation which occur from time to time to physicians, or nurses, and to others who may be brought into proximity with those suffering from the disease, and who through inadvertency, or suffering from wounds, or having abraded surfaces either of the skin or mucous membrane, are so rendered especially liable to attack. In the absence, as yet, of animals satisfactorily shown to be liable either naturally or artificially to the disease as it occurs in man, these accidental cases furnish us the only proof available of the primarily local nature of diphtheria. Such cases as the following are conclusive to myself at least:

A man of twenty-two or twenty-three, being in constant attendance upon a younger brother who had a very severe attack, while using the steam atomizer to the patient's throat, upset the apparatus and scalded extensively the dorsum of his foot, so that in removing his stocking the epithelium came with it. While quietly resting in the next room, with the scalded member properly dressed, within twenty-four or thirty-six hours of the accident, a distinct membranous formation took place upon the wounded surface. Very little constitutional disturbance followed immediately, and in a week or ten days health seemed fully restored. A week or two after this accident this young man went to reside in the country at some distance from the city, and enjoyed apparently good health for about two months, at the end of which time he developed rapidly locomotor disturbances precisely like those which characterize ataxy; he soon found his way to my office, very much alarmed at his staggering gait and loss of muscular strength. I soon quieted his fears through the positive assurance that his paresis was the result of his diphtheritic attack, and with the promise of comparatively speedy cure, which was soon realized.

Now, if diphtheria is primarily a constitutional affection, and the membranous formations taking place in the throat and respiratory passages are to be regarded as secondary and as the characteristic lesion, then ought we to have this kind of manifestation, and always there located, whatever be the point of entrance of the germ into the system?

Experiments upon animals, so far as they go, most certainly appear to negative this view, since whatever toxic and constitutional effects are produced only appear after a certain length of time, greater or less according to the nature of the animal and other modifying circum-

stances, and such tissue-changes as are appreciable are only to be seen about the point of inoculation, and are here persistently localized. There is, likewise, general accord in the observation that only at the seat of the membranous formation in the natural disease and at the point of inoculation in that artificially induced, are there seen to be active growth and multiplication of the pathogenic microbes, while their absence from the blood and internal organs in any considerable number supports the opinion that whatever constitutional and toxic symptoms may occur are due to the absorption of a morbific agent produced, if not directly by the microbes, at least at the seat of their greatest activity. Not uncommonly cases occur in which the sole evidence of disease is to be found in the local manifestations; the thermometer shows an insignificant rise of temperature, the appetite continues good, digestion unimpaired, and every function seems to be performed with regularity and precision; yet the patient may have a more or less extensive membranous formation involving not only the tonsils but the greater portion of the faucial mucous surfaces as well. These walking cases excite no anxiety, unless in anticipation, since our worst fears are sometimes realized by sudden extension of the morbid process into the larynx and trachea, and the patient, who had never suffered from constitutional disturbance, dies from the mechanical obstruction to respiration, unless promptly relieved by surgical procedure.

The success or failure of tracheotomy or intubation will depend, in our opinion, upon this important fact, whether the subject has or has not been poisoned by absorption of the septic material generated, in all cases, at the seat of local infection, but happily not in all cases absorbed, from whatever undetermined causes. It is from the fact that no differentiation is made between these two classes of cases, which we may term benign and malignant, that there prevails so little agreement among practitioners as to the advisability of these surgical procedures in laryngeal diphtheria, and a corresponding absence of harmony in the reported results of such operations performed.

We may say, then, that diphtheria is both an infectious and an infective disease; that the morbific element may be transmitted through a variety of media, floating freely through the air and mingled with the many atmospheric impurities we breathe (Prudden has found the streptococcus floating in the dust of the room in which

the disease originated), polluting our food and drink, and so, in either case, finding a lodgement upon that mucous surface which is the most frequent seat of its first appreciable action.

We may readily conceive how multitudinous may be the media of transmission when we reflect upon the carelessness of those who come in contact with the sick—badly instructed nurses, and other attendants, who are careless of their hands and of their clothing, and who allow towels and handkerchiefs upon which the secretions have been received to be thrown carelessly among the soiled linen of the household; upon the culpable negligence of physicians occasionally, who, without exercising due precaution, carry the contagium from house to house upon their person and instruments: thus I have known of a physician, on removing the thermometer from the patient's mouth, to wipe it carelessly upon his pants and to replace it in that condition in its case!

By one of these many means of conveyance the germs gain admittance to the most accessible mucous membranes of the body and there find suitable accommodation and lodgement. Their subsequent activity, growth, and potency for evil will depend upon several circumstances; among others, most probably, the present state of the mucous surface upon which the lodgement is made, the age, existing health and predisposition of the individual, but of the precise nature of which we know confessedly little.

So Prudden, in his examinations of the throat and tonsil scrapings of forty children who had been exposed to the disease, found the streptococcus present in twelve of them, and in only two of these fatal diphtheria soon followed. This great difference in susceptibility to the same morbific agent shown by those who have been equally exposed to its influence, is a matter of common observation which yet remains quite obscure, and apparently beyond the reach of satisfactory explanation. The local changes once established in those obnoxious to the contagium, become the focus for the generation of the septic material which, in a certain proportion of cases, is absorbed and disseminated throughout the system, and hence we may characterize the disease as infective in these.

There is apparently a striking similarity between the behavior of the poison of syphilis and diphtheria. In either, after the development of the local manifestation, there may occur constitutional dis-

turbances directly following, which we characterize as primary; in either, too, at a more remote period, secondary symptoms which declare the persistent influence of the subtle poison. Nor in either can we determine, with any degree of precision, at the inception of the disease and the beginning of the local lesion in any given case, what and how great will be the systemic infection, or, indeed, whether there will be any constitutional disturbance at all.

Believing that diphtheria is a specific infectious disease, due to the morbid influence of a distinct microörganism upon the tissues of the body, we may justly suppose that certain conditions, climatic and telluric, are more or less favorable to its propagation and spread, and that there may exist important relations between certain localities and the corresponding prevalence of the disease. So far as I am aware, no such relationship has been proven to exist, nor have there yet been observed sufficiently frequent connections between special conditions of climate, soil, season, temperature, sewage, etc., and the prevalence of this disease as would seem to stand in a definite and certain relation of cause and effect.

In general terms, we may assume that diphtheria is subject to the same laws of hygiene which govern in the propagation or abatement of other infectious or germ diseases; but we know nothing for certain in this regard, nor have we collected such a number of reliable observations as to enable us to formulate definite rules for our guidance in its arrest.

Recognizing the liability to pollution of air, water, and soil through the lodgement of germs and the preservation of the vitality of these for varying periods, and, in certain species, their growth and multiplication, our investigations must look to the discovery of whatever relations may exist between these several media and the prevalence of the disease; when, where, and how do these, as well as food and drink, become the harbingers as well as the vehicles for the transportation of this contagium.

Uffelman has shown that the bacilli of typhoid fever may live for several months in a mixture of feces, urine, and earth, and even multiplication to a limited extent may occur. Cholera bacteria have been found alive at varying intervals of from two or three to fifteen days, when mixed with human excrement, soil, and water. Other germs, as the tubercle bacillus, the pyogenic cocci, the bacillus of

tetanus and malignant œdema, find suitable lodgement in the ground, and in certain kinds of soil those conditions suitable for their nourishment and multiplication. These facts, so well established in regard to the habitat of various germs, render plausible those observations which have been made to show an etiological connection between stated outbreaks of diphtheria and particular dairies. We may very readily conceive that the filthy accumulations from these may furnish favorable conditions for the lodgement of microörganisms, for the preservation of their vitality, and a veritable hot-bed for their culture. In polluted milk coming from this focus of disease we have ready at hand the most potent vehicle for dissemination of the contagium.

Mr. Power's communication to the Pathological Society of London, in 1879, is full of interest and contained his researches regarding an outbreak of diphtheria, then recent in the north of London, which appeared to prove that the "distribution of the disease corresponded with the distribution of a particular milk, and that, in this instance, the wilk was the cause of the diphtheria. In like manner Mr. E. L. Jacob, Medical Officer for the Surrey United Sanitary District, in his annual report, claimed that a severe epidemic occurring at Leatherhead in January, 1878, was caused by milk. The details in these cases are so fully and accurately stated as to leave little doubt in the mind as to the etiological relation between these particular outbreaks of diphtheria and some peculiar condition of the milk.

The most important question is left unsolved—viz., how had the milk become contaminated, whether from a diseased state of the cows from which it was taken, or from some source of infection not immediately connected with the animal, but furnished by those filthy surroundings of dairies which so commonly prevail.

Statistics of the disease in St. Louis for the last three years are at least suggestive of the truth of such observations, as they show that a far greater prevalence of the disease—three to one—obtained in those districts of the city which contained numerous dairies and cow-sheds than in those containing few or none. The accompanying table, kindly furnished me by Mr. Charles W. Francis of the Health Department of St. Louis, may be of interest as showing this connection, as well as another fact worthy of note in the study of the etiology of diphtheria, and that is, its far greater prevalence during the fall and winter months than in those of spring and summer.

Year.	January.		February.		March.		April.		May.		June.		July.		August.		September		October.		November.		December.		Total.	
	Cases.	Deaths.	Cases.	Deaths	Cases.	Deaths.	Cases.	Deaths	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.	Cases.	Deaths.
1886	124	45	94	35	82	42	107	24	100	28	123	32	138	48	187	57	292	85	429	106	690	123	460	94	2826	719
1887	313	82	183	47	182	41	138	52	158	50	125	43	113	46	254	62	427	135	457	115	440	139	318	115	3108	927
1888	231	88	139	46	164	60	137	44	89	34	93	34	64	15	88	27	131	48	215	61	132	47	175	60	1658	564

District No. 1. South of the Mo. P. R. R. and east of Grand Avenue. Embracing 9 wards (3, 5, 7, 9, 11, 13, 21, 23, 25). Estimated population, 146,000. 3770 cases—1035 deaths.

District No. 2. Between the Railroad and Washington Street and east of Grand Avenue, embracing 7 wards (1, 2, 15, 17, 19, 20, 22). Estimated population, 120,000. 923 cases—282 deaths.

District No. 3. North of Washington Street, embracing 9 wards (4, 6, 8, 10, 12, 14, 16, 18, 24). Estimated population, 143,000. 2188 cases—657 deaths.

District No. 4. Outside of Grand Avenue, embracing 3 wards (26, 27, 28). Estimated population, 50,000. 711 cases—236 deaths.

Memorandum in Relation to Cow Stables.

In the 1st, 2d, 3d, 4th, 8th, 15th, 17th, 19th, 21st, 22d, and 24th Wards there are no dairies.

In the 5th, 6th, 10th, 14th, 16th, and 20th Wards there are less than five dairies in each ward.

In the 7th, 9th, 11th, 13th, 23d, and 25th Wards (District No. 1) there are *197* dairies and *4318* cows.

The remainder of the dairies are in the 12th and 18th Wards, and in the district outside of Grand Avenue, the 26th, 27th, and 28th Wards.

The 5th, 7th, 9th, 11th, 13th, 23d, and 25th Wards are wards in the district south of the railroad track, and which in this table is called District No. 1.

The 1st, 2d, 15th, 17th, and 19th Wards are wards where there are no dairies, which is marked District No. 2.

The 12th and 18th Wards are in what is marked District No. 3.

The 1st, 2d, 15th, 17th, and 19th Wards, in which, as shown above, there are no dairies, are in the closely built-up part of the city, and include the large tenement houses. In this district there have been comparatively few cases of diphtheria.

The remarks of Mr. Francis are pertinent—he says:

"My theory is this: that diphtheria is a contagious disease, that it becomes epidemic at certain times, and that there are certain conditions that very much increase and exert a very marked influence upon it; and I believe that while the sewers have ordinarily very little to do with the disease, still, when these sewers are connected with certain establishments where diphtheria is prevalent or epidemic, they then become a very important factor in its propagation and spread. These establishments that I refer to are cow stables and dairies.

"The sewers which start in the Twenty-first Ward pass through the Seventh and Eleventh Wards. The neighborhood at the head of these sewers is sparsely built-up and the streets not having been graded many of the manholes and sewer-inlets stand far above the present grade, and, therefore, the sewers receive but little water to flush them out. Right here, at the head of these sewers, there are thirty-three dairies with nearly 1000 cows, and all of these dairies discharge their filth and manure through these sewers. Passing down through the Ninth Ward, we find on the line of these same sewers nearly twenty dairies that are connected with them, and here we have had the greatest number of cases of diphtheria. Following down into the Seventh Ward, we have twenty-five dairies, nearly all of which are connected with the sewers, and in this locality also diphtheria has raged very badly. Go down into the Twenty-fourth Ward, where they have only one main sewer, and, while the disease has extended all over the ward, the worst portion and greatest number of cases have been on the line of this sewer and its branches; and there, too, you will find several dairies connected with it.

"In the commencement of the winter the Department had the sewers in the Ninth and Twenty-first Wards examined and flushed out. Some of them were found almost clogged with manure from the cow stables. The flushing out of these sewers itself was found to have a marked influence on the prevalence of the disease."

Whatever influence may be exerted by such conditions as these, it cannot as yet be considered as proven that diphtheria is, in the strictest sense, a filth disease, for this view is controverted by the fact that the prevalence of the disease does not always correspond with the sanitary condition of the surroundings. Instance New Orleans, in which the death-rate is not one-half that of New York, Philadelphia, or St. Louis, of whose sanitary state Dr. Joseph Holt, President of the State Board of Health of Louisiana, says:

"As to the present condition of the city in respect of its streets, gutters, and drainage, it is possible the condition of these might be worse, but I am unable to imagine a condition more deplorable."

By reference to the vital statistics of other cities, we find confirmation of the observation regarding the relative prevalence of diphtheria

in summer and winter. In Baltimore,[1] in 1888, there occurred during the months of September, October, November, December, January, and February, 122 deaths from this disease, while during March, April, May June, July, and August, there were only 60. In Philadelphia,[2] during the year 1887 (the latest report obtainable), the deaths for corresponding periods numbered 259 and 157 respectively. In Charleston, S. C.,[3] for the year 1888, there were 18 and 3. In New Orleans, for the year 1887,[4] last report, the numbers are 125 and 60; for 1886, 65 and 30. In Cook County, Illinois, for the year 1886,[5] there were reported for the corresponding periods 677 and 525.

If we study these tables, we observe that the disease has exhausted itself about the middle of the summer, starts out afresh and with apparently renewed vigor about September, or the early fall, reaches gradually its acme toward midwinter, from which season it gradually declines again until the lowest point in its annual circuit is attained in the hot season. It shows a marked tendency to rise and fall at certain periods of the year. This peculiarity of diphtheria has been noted by several observers, and among others Drs. Ernest W. Bowditch and Henry B. Baker, who remark the coincidence of increase and abatement of the disease with the opening and closing of the schools.

The explanation suggests itself that in this congregation of children we find the conditions most favorable for the propagation and spread of the disease. Another possibility, however, presents itself to account for the greater prevalence of the disease during the winter than in the warmer months of spring and summer—to be found in the thorough ventilation which pertains during the dog days when all windows and doors are open, allowing a free passage of air and currents through all parts of the house, while during the winter, especially in colder climates, the houses are practically hermetically sealed, and we have thereby a concentration of the contagium and a far greater aptitude for the transmission of the disease from person to person.

[1] Annual Report Health Department, City of Baltimore, 1888, Table X., page 222.
[2] Annual Report Board of Health, Philadelphia, for 1888.
[3] Annual Report Department of Health, City of Charleston, 1888.
[4] Biennial Report Board of Health, General Assembly State of Louisiana, 1886–87.
[5] Ninth Annual Report State Board of Health, State of Illinois, Table III.

This view is in correspondence with the different degrees of prevalence of diphtheria in Northern and Southern latitudes. In Philadelphia and St. Louis, for example, where the winters are severe and the thermometer stands often for days and weeks about the zero point, we find the death-rate to be 1.11 per thousand of the population, while in Charleston and New Orleans, where the thermometer very rarely falls to the freezing-point, it is only 0.38 per thousand.

I have already passed the limit of allotted time, and am conscious of having sufficiently taxed your time and patience. I cannot claim to have done more than to give an outline of the wide, and as yet hardly explored field of inquiry, and to have offered a few principles upon which those inquiries are to be based. We are satisfied that diphtheria is a preventable disease, and yet, alas, we can formulate no definite plan for its prevention, since we are still in ignorance of the laws which govern its origin and propagation. In the absence of such knowledge we have but one course to pursue—to be biassed by no exclusive theory however plausible, but to advocate and put into practice those broad principles which apply both to public and individual hygiene.

DISCUSSION.

Dr. I. E. Atkinson: I think that there is one point beyond which at the present time we cannot go, that is, that we have such a disease as diphtheria. That is to say, a specific disease following certain specific influences; at the same time, I think that there is no doubt that diphtheritic processes are produced by a number of different causes. I think that there is little doubt that the diphtheritic process which we have in ordinary diphtheria, and the membranous formations found in such conditions as scarlet fever, while quite alike in their objective features, are not due to the same etiological influence. I think that investigations have shown that the process seen in scarlet fever is etiologically different from that seen in ordinary diphtheria. I recall the records of some three hundred cases of diphtheritis faucium in scarlet fever by Heubner and Hoven, and in none of these cases was there a single one of the paralytic sequelæ so commonly observed after diphtheria. I do not believe that we can find such a number of cases of diphtheria without these secondary results.

I think that we must recognize that there are a number of etiological conditions capable of bringing about this inflammation and these processes.

Given an organism that is capable of multiplying in the mucous membrane, causing in it necrotic inflammation, and of generating substances which upon absorption infect the body, there is no reason why we might not, under the influence of a number of organisms, have processes that result in identically the same way. This is perfectly familiar to every one in the study of the various organisms that are capable of producing pus. We probably also have a number of minute organisms that are capable of causing the pneumonic process. Under the influence of the tubercular organisms, pneumonic processes are produced which are like other pneumonic processes.

It seems to me that the study of the diphtheritic process as we have it from the investigations of Dr. Prudden, promises that the disease we call diphtheria may be found to be due to minute organisms with which we are quite familiar as producing other forms of morbific action. I think that we shall find that there are a number of diphtheritic processes quite unmistakable in their clinical history, which may be due to more than one organism.

Dr. Henry F. Formad: I wish to call the attention of Dr. Robinson to a paper by Dr. H. C. Wood and myself, published about 1881, containing observations on diphtheria made for the National Board of Health. I was myself in Michigan, in the very hot-beds of diphtheria, among the wood camps. I may state that in places where there is a great deal of sawdust, diphtheria prevails more than anywhere else.

In 1880, we discovered a micrococcus in the blood and tissues of diphtheritic patients, probably similar to the one described by Dr. Prudden. It is described and pictured in the paper referred to. We succeeded in growing this micrococcus in cultures, and found that it had pathogenic properties. Subsequently, Loeffler discovered a bacillus of diphtheria, and our micrococcus was lost sight of. Now, if I understand Dr. Robinson correctly, it seems that Dr. Prudden also fixes on a micrococcus, even if it be in the form of streptococcus.

A SUPPLEMENTAL INQUIRY INTO THE FREQUENCY WITH WHICH LEAD IS FOUND IN THE URINE.

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At a meeting of this Association in June, 1887, I reported an analysis of eighty-six cases, not presenting unequivocal symptoms of lead-poisoning, where the urine had been examined for lead. In forty-eight of these cases lead was found; in thirty-eight it was absent.

The question which I had in mind in making the investigation was whether long-continued exposure to very small quantities of lead gives rise to other symptoms than those commonly reported; and if so, whether such symptoms are sufficiently characteristic to lead to at least a presumptive diagnosis.

The conclusions which this investigation seemed provisionally to justify were the following:

1. It is not probable that lead is to be detected in the urine of more than fifty per cent. at most, of persons not presenting symptoms of disease, and the finding of lead in a larger percentage, for any special group of cases, would be presumptive evidence that lead was connected, directly or indirectly, with the production of the symptoms.

2. That lead is an occasional cause of chronic sensory neuritis, and chronic or subacute myelitis, and sometimes gives rise to the symptoms of spastic paraplegia.

3. That lead is an occasional cause of pure neurasthenic symptoms, and the presence of a fine muscular tremor strengthens the probability of this diagnosis.

4. That workers in rubber are liable to suffer from lead-poisoning.

The investigation which is the subject of the present paper was undertaken, primarily, to control the first of these conclusions, as to the frequency with which lead is to be found in the urine of healthy persons.

For this purpose I first obtained thirty specimens of urine from medical students, and had them analyzed by Dr. A. M. Comey, who had so carefully performed the earlier analyses. These gentlemen were living, as a rule, in boarding-houses in the city, and came originally from various parts of the country. Potassium iodide was taken in each case for four days before the urine was collected. Slight traces of lead were found in three cases, or 10 per cent. In one of the three cases a second analysis failed to detect lead; in the other cases no second analysis was made. The students in whose urine the lead was found appeared to be in perfect health.

In order to make the same inquiry with regard to a class in the community living under poorer circumstances, I obtained, through the kindness of Prof. F. C. Shattuck, specimens of urine from a number of patients at the Good Samaritan Hospital. Thirteen of these patients were suffering from phthisis or pleurisy; in three cases lead was found in the urine. In four cases, presenting simple anæmia and debility, lead was absent; but as lead might have been the cause of these symptoms the cases are excluded. In a case of acute Basedow's disease, brought on by severe fright, lead was also absent. The same was true in two cases of paralysis agitans, and one of acute chorea.

Besides these cases, I have had analyses made of the urine from a number of patients presenting themselves at the out-patient department of the Massachusetts General Hospital, suffering from some disease, either strictly local or, so far as we know, not attributable to lead, and from a few suitable private patients.

In all, we have fifty-seven new analyses from persons who might be said to be from our point of view without symptoms. In ten of these, or 17.5 per cent., lead was found, usually in slight traces.

It is doubtless true that if more refined methods of chemical analysis could have been employed, and larger quantities of urine, besides other secretions and excretions, have been subjected to analysis, the number of cases belonging to this group in which lead was present would have been greater. If to these we add the eleven cases reported upon two years ago, we have a final total of sixty-eight cases, in 17.6 per cent. of which lead was found to be present, and so far as we now know, therefore, this proportion may be taken as about representing, or probably rather under-representing, the frequency with which minute

quantities of lead are present in the tissues of practically healthy persons.

If, to compare with this group, we add together all the cases from the two investigations of which it cannot be said positively that they presented no symptoms which would commonly be said to be attributed to lead, we have a total of 117, in 62, or 53 per cent., of which lead was found. Even if we add in the cases presenting no characteristic symptoms, raising the total to 186 cases, we still find that lead was present in 40 per cent., or more than twice the proportion found in the first group.

This comparison makes it probable that lead is at least a partial cause of a variety of symptoms not usually attributed to that cause.

Case.	Symptoms.	Former series.	New series.	Total.	Lead present.	Lead absent.	Percent. in which lead was present.	
1	No symptoms not attributable to other causes	11	57	68	12	56	17.6	
2	Fine muscular tremor; nervous debility	8	2	11	11	0		
3	Chronic multiple neuritis; neuritis with chronic and subacute myelitis; spastic paraplegia; multiple sclerosis	19	24	43	27	16		
4	Progressive muscular atrophy	4	1	5	0	5		
5	Cerebral and cerebro-spinal cases	7	2	9	7	2	53⅓	40
6	Epilepsy	8	4	12	4	8		
7	Sciatica	2	1	3	0	3		
8	Acute polio-neuritis	0	2	2	0	2		
9	Digestive disorders	0	2	2	0	2		
10	Simple anæmia and debility	0	4	4	0	4		
11	Remaining cases from former series	26	...	26	13	13		
12	Rubber-workers	0	8	8	5	3		
13	Optic neuritis	0	2	2	2	0		

No statistical importance is to be attached to these ratios except as stated in the text.

No doubt the composition of this table is open to a variety of criticisms; one of which might be that quite a large proportion of the patients presenting symptoms of organic disease were laboring men, whose lives would expose them to a relatively large number of the many sources of lead-contamination, and, at the same time, to other, and perhaps the real causes of their disease. Nevertheless the numbers are sufficiently striking to make it worth while to examine the groups of cases in which lead was found for indications of its influence.

I recognize that this attempt should be made in a conservative spirit,

for it is evident that the presence of small quantities of lead is not only compatible with health, but does not necessarily complicate other existing diseases. Thus, one of the cases noted in the earlier paper was that of a gentleman suffering from sarcomatous disease within the pelvis. Lead was twice found in the urine in the course of his illness, yet, in spite of the presence of this poison in his tissues, and the depressing influence of the organic disease, which eventually proved fatal, he exhibited no marked signs of anæmia or impaired nutrition until a comparatively short time before his death.

One group of cases, the patients being a father, mother, and three children, is especially important in this connection. The water used by this family at their country house, where they spent a considerable part of the year, ran for quite a distance through lead pipes, and was found to contain a large quantity of lead. Repeated analyses showed that lead was present in considerable quantities, in the urine of two of the children, the father, and the mother, though for some reason, not easily to be explained, not in that of the third child. All these children were in fair health. One of them, however, has been very subject to sharp attacks of gastric indigestion, pain in the left side, and vomiting preceded by sore throat; and also to constipation, which was worse during the attacks of indigestion. When the lead was found, small doses of iodide of potash were given, but seemed to precipitate the attacks above mentioned, and was, after a number of trials, abandoned by advice of her physician, who believed her attacks to be due to imperfect power of digestion. A possible cause for this imperfect digestion is, obviously, the lead. She became, finally, perfectly well, but still has to be careful with her food.

Another child, a sister, in whose urine, also, lead was found, is said to have had a few attacks of indigestion and occasional clay-colored stools.

A third child, a boy, who was thought to have drank even more of the water than his sisters, had no lead in his urine, according to two analyses, and no symptoms. The father and mother were perfectly well, though their urine contained a considerable amount of lead. It is a remarkable fact that in the extensive outbreaks of lead-poisoning from drinking water, occurring in certain English towns, children have seemed to suffer much less than adults, but the lighter grades of symptoms were probably not taken into account.

There is obviously a danger that in seeking to account for pathological conditions of obscure origin that arise in the presence of an agent like lead, we may, by including symptoms that are due to some other cause, obscure instead of illuminate the true clinical picture.

For this reason, I prefer to suspend judgment altogether as to the etiological diagnosis of the cases to which I shall next refer, and shall only point out their likeness and unlikeness to typical instances of lead poisoning, and let the decision wait for the further accumulation of evidence.

The largest group of cases analyzed in the earlier paper was that comprising nineteen cases of chronic generalized neuritis, neuritis with chronic myelitis, myelitis with symptoms of spastic paraplegia, and multiple sclerosis. In 15 of these cases lead was found to be present, and in 4 it was absent. I can now add to this group 24 similar cases, equally divided between those in which lead was present and those in which it was absent. To these ratios we cannot attach much importance, because the cases do not form a strictly homogeneous group, and those which are essentially alike, are not in sufficient number to warrant statistical conclusions of real value. The greater part of the cases of this group may be subdivided as follows, into:

1. Those in which subacute myelitis was present, usually associated with profound disturbance of the general nutrition, and generalized neuritis.
2. Those characterized by the symptoms of spastic paraplegia, without signs of any marked impairment of general nutrition.
3. Cases apparently of chronic neuritis.
4. A case of subacute neuritis, with neuralgic symptoms.

Before taking up the first sub-group, that characterized by subacute myelitis, I will state briefly what, in my opinion, we may define as our present state of knowledge with regard to the effect of lead upon the nutrition of the spinal cord, as a point of departure for our inquiry.

I do not propose to reopen the whole discussion of this subject, but will ask you to admit as representing, at the least, a sufficiently cautious and conservative position the views expressed by Prof. Schultze in a critical paper accompanying the report of an anatomical examination, published in the *Arch. für Psychiatrie*, for 1885.

This writer points out, after carefully reviewing the evidence, that there is as yet no sufficient ground for the theory that the well-known and constant changes in the nerves and muscles seen in the typical paralysis of the forearm extensors, are secondary to spinal disease which some observers have believed to be always present even though latent; and that, in the cases where myelitis is found, of which there are but very few on record that are above criticism,[1] the spinal changes do not stand in any coördinate relation to the peripheral changes, and are not coextensive with them, but form an independent lesion, and are, as he thinks, indicative of a later stage and a more generalized form of poisoning than that implied by the neuritis alone.

A similar view has been upheld by Zenker, and other writers. It is only open to one criticism, as it seems to me, and that is, I think, an important one; namely, that the evidence before us is as yet too meagre to admit of our asserting, with any degree of confidence, that myelitis occurs only in cases of "severe and generalized poisoning." If we admit that it is not the cause of the typical paralysis, and that when it occurs, it is as an independent lesion, we might fairly expect that, like the other independent lesions of the same origin, it should come to the front in some cases and remain in the background in others, in the most unexpected manner, until the contrary has been proved.

This probability gains in weight through the interesting clinical distinction made by Gowers, between the muscular atrophy due to degeneration of the peripheral nerve (the usual type), and that analogous to progressive muscular atrophy, which affects by preference a somewhat different set of muscles from the usual form and runs a different course.

As to the form which the spinal affection probably takes when it does occur, so far as we may judge from the very few cases on record, it is of the polio-myelitic form, except that v. Monakow found patches of sclerosis, and Vulpian, in a dog, granular cells and other signs of subacute diffused myelitis. Monakow's case is considered by Schultze as not a clear one, since some of the symptoms and some of the lesions, including the spinal sclerosis, suggested the presence of paralytic dementia.

[1] Neither Schultze nor Oppenheim refers to Dr. Birdsall's case, published in 1881 (Journal of Neurology and Psychology, N. Y.), nor to those of Moritz (Dreschfeld and Young), Journal of Anatomy and Physiology, October, 1880; and of Seguin (unpublished) which are cited by Birdsall.

It has, further, been asserted by Monakow and by Oppenheim, that the cells groups of the anterior horns which appeared to have suffered the most were those of the anterior and median portions of the horn, and I was especially interested in this statement because the same condition appears to be present in some specimens of my own, which are about to be described. Schultze, however, thinks that this relative scarcity of nerve cells in these parts of the anterior horns is sufficiently common in healthy cords, and, although he found it in his own case of lead paralysis, he does not attach much importance to the appearance, unless associated with other signs of destruction of tissue.

Finally, another important change quite generally noted in the reports of the examinations of the cord, is thickening of the smaller arteries.

As a rule, this was associated with nephritis, and it is a condition often seen, apparently as a secondary feature, in chronic spinal cases. Still, it is pretty certain that the thickening of the vascular walls may occur in various organs as a direct result of lead poisoning, and it may have an etiological significance apart from the nephritis, as will be pointed out later.

The only case of which I shall speak at length was briefly reported in the paper of two years ago. The patient has died since then, and I have had an opportunity to examine the spinal cord, sections from which are now under the microscope.

The patient was a man, married, fifty-two years old, and a carraige-painter for thirteen years, who consulted me on January 20, 1887. His personal antecedents had been good in all respects, except that he had always been of somewhat delicate constitution and rather more than usually slow and quiet in disposition. His mother had, however, presented symptoms somewhat resembling his own, as will be shown further on. He had been practically well up to the autumn of 1885, although his wife said that, on looking back, she could recall that the pallor of the skin, with yellowish cast, of which more will be said presently, had begun to show itself even two or three years before that date. His first special symptoms consisted in a sense of numbness of the thumb and finger-tips of both hands. This remained through the winter, then grew less, but afterward returned. In the spring of 1886, the paleness of his skin first began to attract the attention of his friends, and he was thought to look poorly through the following summer. In the autumn, his feet began to trouble him as his hands had done, and, soon after, the same feeling spread to the knees, hips, and back, and was accompanied with a general weakness, so great that in September, 1886, he gave up work.

At the time of consulting me, in January, 1887, the numbness had returned in the hands and arms, and was associated with considerable generalized weakness, though without signs of local paralysis. He complained of great constipation, but gave no history of lead colic; also, of marked sensitiveness to cold, and a moderate weakness of the eyesight, perhaps due to his age, but which had increased rather more rapidly than would have been expected. The numbness and prickling were not of the recurrent type, but were constant, and these, with the general weakness, constituted the main features of the case. His appetite was good, his sleep regular, and there was no weakness of the sphincters at that time.

The physical examination showed marked pallor of the skin of all parts of the body, with a distinctly yellowish or dirty yellow cast. His gait was slow and feeble, and with a certain exaggeration of movement, due apparently to paresis rather than to incoördination, and there was at first no marked loss of balance on closure of eyes. There appeared to be no localized paralysis. Every movement was possible. There was no incoördination of the arms. It is especially noted that extension of the fingers did not seem deficient. He could raise himself on the toes of both feet together, but not on one alone. There was general emaciation, but no marked localized wasting. There was no severe spontaneous pain in the head or elsewhere, although at a later period he suffered much from pain in the knees and ankles on walking, and from pain between the elbow and shoulder of the right arm, and especially on motion of the arm.

The knee-jerk was exaggerated on both sides, and ankle-clonus was present. A careful examination of the forearm muscles of one side, with the faradic current, gave the following figures, corresponding to moderate diminution of irritability, generally, and especially of the extensor muscles as compared with the flexors:

Ext. long. dig., 83 mm.

Flex. com. dig., 98 mm.[1]

Sup. long., 90 mm.

The galvanic resistance was found to be the same for the two surfaces of the arm.

No indications of cardiac or renal disease were found, either by the patient's family physician, Dr. C. C. Tower, of South Weymouth, or by myself.

There was no blue-line on the gums, but lead was found in his urine, once, at this period, and, again, about six months before his death.

The further history of the case—which I learned partly through personal examination from time to time, and, later, through letter from the patient's physician and wife—is one of gradual increase of all symptoms. The general wasting and loss of strength steadily progressed, with the notable exception that, at first, under a vigorous tonic treatment, with a large amount of nour-

[1] The figures for a healthy person with the same apparatus would have been about 110 mm. to 120 mm., with some difference between the flexors and extensors, but hardly so great a difference as is shown here.

ishment, there was a marked temporary improvement. The nails showed longitudinal ridges. On June 1, 1887, it was noted that complete extension of the carpus and fingers—*i. e.*, extension above the line of the forearm—was very imperfect, and, at the same date, the faradic reactions of the arm muscles were found everywhere preserved, but markedly diminished for the extensors of the fingers as compared with the flexors. It was, however, found that under a sufficiently strong current there was no sluggishness of the contraction, and that there was no qualitative change to the galvanic current. The faradic reaction of the ext. quad. cruris was diminished, but there was no qualitative change.

Some of his symptoms at this period, and earlier, were of cerebral character, probably circulatory or anæmic. Thus, on April 26th he fell, without distinctly losing consciousness, and from this time on his downward progress was more rapid. A little later, he had attacks in which he would feel very cold, and would sometimes shake; and if in bed would have extensor-cramp of the legs. After a time, his legs began to swell slightly; and he had difficulty in retaining his urine. He was, also, dizzy at times, and once or twice was slightly out of his head for a few hours. His weakness increasing, he went from canes to crutches, and was, finally, unable to support himself with these. He suffered much from the joint pains above mentioned.

On November 22d, his physician, Dr. Tower, writes: "His decline for the past month has been very gradual, but steady. Yesterday, he manifested some difficulty in raising the mucus from his bronchial tubes, and, last evening, he was suffering from dyspnœa, apparently due to want of innervation. The pulse was quite distinct but weak, about 84 to the minute. The respiration was 24. This morning the pulse was 96; the respiration 28. At my visit, this morning, he was lying in an apparently unconscious state, but, later, manifested signs of consciousness."

He died later in the day, and, through the kindness of Dr. Tower, I was able to be present at the autopsy, and to obtain the cord and a few nerves for microscopic examination. Of the rest of the organs there is nothing to be said, except that the emaciation was extreme, and the muscles, as well as the other organs, excessively anæmic. The kidneys appeared normal, but were, unfortunately, not examined microscopically. To my great regret I cannot report upon the histological condition of the gastro-intestinal tract and of the blood. In view, however, of the important part played, as I believe, by the general anæmia in the production of the symptoms and the spinal-lesions, I cannot forbear to call attention to the probable presence of atrophy with its associated changes in the stomach and bowels, and to the well-known observations of Maier as to the powerful effect of lead in exciting such changes. At the time I first saw this patient his appetitite was poor and the quantity of food taken was small. Under forced feeding, iron, arsenic, and cod-liver oil a marked improvement in color and strength took place, which, however, failed to maintain itself in spite of careful treatment—indicating failure on the part either of digestion, or of the blood-making power. A piece of the anterior tibial nerve, and a number of small cutaneous nerves from the skin

over the anterior part of the thigh, were removed, and stained in osmic acid. The cord was placed in Müller's fluid, and was examined, first, after about two weeks, for granule-cells. These were found in great abundance, especially in the posterior median columns, and extending beyond the strict limits of these tracts; also, in and around the lateral pyramidal tracts and in the neighborhood of the anterior root zones. After hardening, the cord was cut and the sections mounted in the usual manner.

The staining fluids used were carmine and Weigert's hæmatoxylon.

The most striking lesions found were, first, a dense sclerosis, limited mainly, though not accurately, to the antero-lateral pyramidal tract, the circumference of the section, and the postero-median columns, except for the lenticular-shaped area, close to the median line, where there are healthy fibres, compactly placed in the lumbar region, and scattering at higher levels, and the anterior part nearest the posterior commissure; second, a more acute process, indicated by a general disintegration of the tissue of the white mantel of the cord, especially in and around the sclerosed parts and, especially, by the presence of round or oval spaces of the size of two or three to ten or a dozen nerve tubes, and, evidently, due to the breaking down of the latter. These spaces were usually empty, but often contained a substance of finely granular appearance, probably the remains of granule cells and myeline; and, here and there, homogeneous bodies staining a pale red with carmine, and, evidently, representing fragments of swelled axis-cylinders; finally, the gray matter of the dorsal and lumbar portions, to a less extent the cervical, was profoundly affected.

In the Weigert-hæmatoxylon stained sections, the area occupied by this process of subacute leuco-myelitis is of a diffuse light blue color, due, no doubt, to finely divided myeline, and the contents of the perforating spaces sometimes show a similar tint.

These changes run through the entire length of the cord. The sections of the nerve-roots show marked signs of disease, and this has affected the posterior much more than the anterior roots. In the sections from the dorsal, lumbar, and sacral region, there are large areas especially of the posterior roots, which contain no fibres, only connective tissue; and the fibres which remain in other parts of the section are altered in appearance, the myeline often swelled in a varicose manner and not staining well with hæmatoxylon, and the usual markings and outlines of the fibres obscured.

In the sections from the anterior roots there are similar signs of destruction of fibres here and there, but, on the whole, the morbid appearances indicate the lesser degrees of change, consisting of alteration of the myeline so that it stains reddish with carmine, and very little with Weigert's hæmatoxylon; perhaps atrophy of axis-cylinders, though this cannot be confidently asserted, and thickening of the walls of the smaller arteries. In the dorsal region the destruction has gone on further than elsewhere.

The medullated nerve-fibres which traverse the cord in the plane of the sections, were often highly varicose, especially those in the neighborhood of

the posterior roots in the lumbar and dorsal regions, and the same is true of the fibres of the gray matter in many places, and of the posterior commissure.

In describing the changes of the gray matter in the cord, I shall try to keep within safe bounds, since it has been shown that the lesser degrees of pigmentation of the ganglion cells, the absence of processes, the paleness of color, the distortion of the nucleus, an apparent reduction in number of cells, and other appearances formerly considered of much importance, may be either compatible with a normal state, or due to imperfect hardening, the action of staining fluids, and the like.

The gray matter in this case presents, so far as I have found, no gross lesions, such as hemorrhage, sclerosis, or softening, and is not altered in shape. The sections, however, indicate that the nutrition of the cell-groups of the middle and lower dorsal region was profoundly altered, that of the lumbar region to a less degree, and of the cervical region still less.

In many of the dorsal sections not a healthy looking ganglion cell is to be seen, and the number of recognizable cells is much reduced. Those which remain consist, often, of only a small mass of granules of vague outline, in the midst of which, however, the nucleus is often to be clearly made out.

The appearances indicate every grade of change between that of terminal destruction and moderate degree of coarse granulation, distinct from the pigmentation.

In the cervical region the cell groups of the lateral process are apparently nearly intact, and as often take the carmine stain better than the rest. The rest of the horn looks deficient in cells, but, on close inspection, a good many relatively pale ones are found, and I cannot positively say that the sections are abnormal in this respect. On the whole, I should not say, from the examination of the cervical gray matter alone, that it was certainly diseased, but the unmistakable changes in the dorsal and lumbar regions make it probable that the appearances seen in the cervical enlargement are also pathological.

In the lumbar region a moderate number of cells is to be found, but a careful examination shows them to be, as a rule, very granular, and to occupy almost exclusively the median and lateral parts of the horn alone. The cells of the posterior horn appear to have been affected like those of the anterior, and most severely at the same levels with the latter.

The column of Clarke was found seriously involved, and at the level of the most intense change the small vessels of this column, as well as those of other parts of cord at the same level, are often packed with blood.

The central canal was everywhere filled with small cells and its outlines wholly lost.

As regards other signs of tissue-change, enlarged Deiter's cells were not found; amyloid bodies were present here and there, but not prominently; there was only a slight accumulation of round cells along the vessels; the

smaller arteries were often a good deal thickened, and showed hyaline degeneration to a moderate degree, but this is not invariably the case, and never so great as I have seen in other cases. Between the nerve-fibres, in many places, a plastic material had collected, which looks homogeneous, and stains with carmine.

The sclerotic process in the posterior white columns was more marked in the lumbar and dorsal region than in the cervical. It reached in a few sections through the lumbar region as far as the commissure, but, as a rule, it leaves the extreme anterior portion unaffected, and, as is so often the case, this relatively healthy area enters like a wedge between the sclerotic areas of the two sides, which, at this portion, diverge slightly. The familiar appearance is also seen of a tongue-shaped area of sclerosis starting from near the posterior circumference midway between the median line and the apex of the posterior horn, and stretching forward and outward in the direction of the base of the horn. The limits of the older sclerosis, in the antero-lateral column were obscured by the more recent changes, but apparently the direct cerebellar tract was not seriously involved.

The open spaces which indicated the later, more acute process, were present in the sclerosed areas to some extent, but were less numerous there, and also much smaller, than on the borders of these areas and beyond. The longitudinal commissural tracts—the column of Burdach and the lateral limiting layer—were relatively unaffected except in the dorsal region, where they were a good deal damaged. Even at other levels, an occasional enlarged axis-cylinder, or one of the other changes, was to be seen in these tracts.

With regard to the peripheral nerves, it is to be regretted that they were represented in the examination only by a small piece of the anterior tibial and cutaneous filaments from the thigh, but the study of these shows what is, after all, the important point, namely, that a larger number of fibres—the great majority in the fragments examined—presented no changes of the myeline sheath incompatible with health. Here and there, however, a highly degenerated fibre was seen. I could not convince myself that the fibres which retained their myeline intact were narrower than usual.

I have given the details of this case, so far as I have them, because of the interest attaching to the anatomical condition, and because it is a good example of a class of cases, the etiology of which, and especially whether they may sometimes originate wholly or in part in lead-poisoning, it is important to discover.

To sum up the facts, we have a man in middle life, living under comfortable conditions, suffering for two years with paræsthesia, anæsthesia, and progressive muscular weakness, without focal symptoms; exaggerated knee-jerk and ankle clonus, and moderate diminution of electrical reactions. We find these symptoms associated with very marked paleness of the skin, of light yellow cast, general emaciation,

and weakness, the whole increasing slowly but steadily, and terminating in complete paraplegia, incontinence of urine, slight cerebral symptoms of general character, and death apparently from exhaustion.

To explain these symptoms, we find, anatomically, besides generalized anæmia, which I am not in position to refer to a definite cause, a combined sclerosis of the posterior and lateral columns of the cord, and, as representing a later process, engrafted on this, a subacute breaking down of the tissues at the seat of the older sclerosis, and beyond the limits of these areas, more or less hyaline hypertrophy of the vessels, a degeneration of the ganglion cells of all the groups, in the middle and lower dorsal region, diminishing in intensity above and below, a marked degeneration of the posterior nerve-roots of the dorsal and lumbar portions, and, to a less extent, the anterior roots. This process is not characterized by signs of acute inflammation, except, to some extent, at the level of most active change. We find, also, indications of some degeneration of the muscular and cutaneous nerves, though far less than would be expected had the whole process been primarily one of neuritis. Finally, the patient's occupation exposed him to chronic lead-poisoning, and lead was twice found in his urine.

Within the past few years I have had seven or eight cases of this general type, characterized by the beginning of the symptoms, sensory and motor, in all four extremities, and a progressive giving out of all the spinal functions, without pain, and in four of these I have made sections of the spinal cord. Two of the specimens are not yet fully examined, but the condition is evidently an analogous one in all of them. All the patients, except this one and possibly one other to be reported later in whose urine, also, lead was found, were women, and in all the same feature of feebleness and pallor, associated two or three times with severe attacks of diarrhœa, was very noticeable. In one of these cases, cited in the earlier paper, lead was present in "considerable quantity," in another case observed, which seems to belong in the same class, lead was found three times, once in quite large amount; in another of the cases lead was absent, while the rest were not examined in this respect, but they presented no other indications whatever of lead-poisoning. Anatomically, the cases would have to be classed as "combined sclerosis," but I think they form a somewhat special sub-group.

With regard to the possible influence of lead in the matter, I do

not in the least suppose that it is the one special cause, or, perhaps, a direct cause at all—though this is no more intrinsically improbable than that syphilis, ergot, and lathyrus should excite spinal scleroses, as these appear to do—but it does seem to me possible that lead may at least act as an indirect cause of spinal sclerosis by causing or increasing general anæmia, and by exciting hypertrophy of the small vessels.

If we glance over the conditions under which the scleroses in general arise, we find, I think, that among the most prominent are an inherited tendency to degenerative weakness, low or depressed vitality, and toxic influences. Thus, syphilis certainly plays an important part in causing locomotor ataxia, and even in causing lateral sclerosis and the scleroses associated with paretic dementia; ergot and lathyrus seem to excite lateral sclerosis; and malaria, and other zymotic poisons have been suspected of a similar influence.

The influence of heredity is most marked in Friedreich's disease, of which a form of combined sclerosis is the most conspicuous lesion; but there are many partial or irregular cases on record, which it is difficult to classify, where the local disease appears to be closely associated with a generally poor state of nervous vitality.

A recent suggestion of Lauder Brunton is interesting in this connection. Referring to the importance of the study of the action of drugs on the production of lateral sclerosis, and especially to the observations of Tuczec on the scleroses of ergot-eaters, he points out that this result is not produced experimentally by injections of ergotine, and thinks that the poverty and famine of the peasants who fall victims to the disease may have a good deal to do with the result.

Of course, many well-nourished persons suffer from typical lateral sclerosis, but then some other distinct cause, especially syphilis, may come in.

Finally, it is highly probable that an excessive local anæmia, even if not absolute, is capable of profoundly modifying the nutrition of the cord. Moxon long ago called attention to this factor probably accounting for the greater frequency of myelitis in the lower end of the spinal cord than higher up, the slender root arteries of that portion having a longer and more tortuous course.

It is not improbable that the same cause is active in cases of myelitis

from pressure, especially if the pressure affects the nerve-roots and their arteries, as well as the cord, as occurs with some tumors.

An interesting case of supposed subacute softening in the dorsal region has recently been described by Max Beck, in an inaugural dissertation, where the anatomical appearances, except that they indicated a more rapid process, corresponded closely with those here reported as forming the acuter part of the disease here described; the same absence of inflammatory signs, the same formation of open spaces from breaking down of nerve tubes and their septa; a similar but perhaps a greater thickening of the vessels. The writer considers the vascular change[1] to have been the direct cause of the softening, and it may be at least admitted as a probable partial cause. This hyaline thickening of the vessels he refers to a typhoid of three years previous, not finding any other cause to which the patient, a woman of twenty-four, had been exposed. Whether this inference was well grounded or not, it will, I think, be admitted that we have, in chronic lead-poisoning, an efficient cause both of general anæmia and of thickening of small arteries, and a possible contributive cause of subacute and chronic myelitis, even, perhaps, of the type of system-sclerosis, which is after all probably little different from system, *i. e.*, motor or sensory, neuritis, transferred to another plane, as Gowers so well points out.

There is, to be sure, an apparent, and perhaps a real incongruity between the appearances in the spinal cord reported on in this paper and those observed after temporary closure of the abdominal aorta, and clearly described by Singer[2] and the authors cited by him.

It was found that this procedure caused a rapid destruction of the gray matter, and next of the limiting layer (longitudinal associating tracts), and the anterior nerve roots, the posterior nerve-roots, and long tracts remaining for a long time, or permanently unaffected. In other words, the essential or intrinsic structure of the spinal cord, namely, the gray matter with its associating tracts and its appendages, the anterior nerve-roots, are the parts which suffer from acute anæmia; while the long tracts, which really belong to the cerebral system, and the posterior nerve-roots, which probably have their nutritive centre in the intervertebral ganglia, are not primarily involved. This general

[1] Resulting as, he thinks, in thrombosis, but not on sufficient grounds, the hyaline thrombi which he describes being probably serum coagulated post-mortem.

[2] Xcvi. Bd. de Sitzb. d. Kais. Akad. der Wissensch. III. Abth., November, 1887.

picture appears just the reverse of ours, and it is plain that here the anæmia, if it is effective at all, must have played a secondary part. But it must be remembered that the nutrition of the dorsal gray matter did eventually greatly suffer; that the sclerosis of the long tracts was an affair of older date; and that the acute softening around and in them very likely occurred there as being the part of which the circulation was the most impaired and the vitality the lowest.

To speak of another possible partial cause in this case, and others of the same kind, I will say that our patient's mother suffered for some years before her death from symptoms which are thus described, from memory, by her daughter:

"For a number of years she was troubled with diarrhœa at times; then she complained of numbness, in her fingers at first (presumably, afterward in the feet), feeling like coarse sand under the skin, with occasional return of the looseness of the bowels. Then there was swelling of the feet and ankles, which finally disappeared. She had the numbness and diarrhœa for a year before the dropsical symptoms, shortly after which she was unable to sit up for several months. She afterward rallied and was about the house for nearly a year, but remained very feeble, complaining of great soreness across her bowels, and having very little control over her limbs. She had an attack of jaundice in July, and died in October. I do not think her head was affected to any great extent, or her back. She complained of her knees being cold, and wrapped them up even in very hot weather."

Apart from the possibility of relationship of developmental origin, between the disease of mother and son, I was interested in this account from the fact that three other of the patients who belong in the group of which I have been speaking, suffered from excessive diarrhœa before and along with the spinal symptoms. I have never felt sure whether there was any connection at all between them, nor whether to consider the diarrhœa as a partial cause of the anæmia, and thus indirectly of the spinal disease, or as itself a result of some anatomical changes in the sympathetic system.

I will not take the time of the Association by describing the other cases in which lead was found in the urine. I will only say here that the list comprises other cases more or less analogous to the one just described; also two cases of optic neuritis apparently from lead-poisoning; for one of which I am indebted to Dr. J. J. Minot and Dr. O. F. Wadsworth; while the other is of interest as exhibiting symptoms strongly suggestive of paretic dementia and yet not justifying that diag-

nosis; further, several cases of chronic sensory neuritis, and one highly interesting and rare case of subacute neuritis with distinctly neuralgiform symptoms, nerve tenderness, and impaired electrical reactions, affecting one nerve after another until in the course of a year all four limbs became involved, the legs only to a slight degree. Lead was found twice or three times in the urine, once in considerable amount. For this case I am again indebted to the kindness of Prof. F. C. Shattuck.

With regard to the diagnostic value of the finding of traces of lead in the urine, it is needless to say again that I regard it as of no necessary importance. Dr. Gowers thinks its significance is much less than that of the "lead-line." Perhaps this is true, but a person may have a marked lead-line and yet no impairment of health. This was strikingly shown not long ago at the Massachusetts General Hospital, where a typical and very bad case of universal drinking-water paralysis presented itself. The patient's aunt, who accompanied him, denied all symptoms of disease, but her gums showed a well-marked lead-line.

I think the result is that it is never safe to say how large a quantity of lead a person may bear, nor how small a quantity may affect him badly, and that we probably do not yet know all the manifestations of the poison.

In conclusion, I wish to say a single word about the source of lead-poisoning in drinking water, an old but ever new subject for investigation and discussion.

Dr. E. M. Greene, of Boston, has recently been making some observations on this subject which show the dangers to which dwellers in our large cities are still exposed.

My own house being unused this summer, and therefore a good subject for study, I asked Dr. Greene to make the following analyses, the results of which are appended:

I. First drawing of water (Ov in each case) from kitchen faucet; the water having lain in a pipe about seventy feet long: large amount of lead found.

II. Water drawn after faucet had discharged for five minutes: lead still present.

III. Water drawn after faucet had discharged for fifteen minutes: traces of lead.

III *a*. Ibid; and then allowed to lie for half an hour: larger traces than in last case.

IV. Water drawn after faucet had discharged for an hour: no lead found.

V. Ibid; and then allowed to stand for three and a half hours; traces of lead.

The water from the faucet at the top of the house (five stories) was found to contain lead after it had been running for half an hour.

DISCUSSION.

DR. WILLIAM H. WELCH: Dr. Putnam is to be congratulated upon his thorough and laborious study of this subject. Dr. Putnam has suggested various ways in which we may suppose lead to act as a direct or an accessory cause in the production of diseases of the nervous system. He seems less inclined to attribute to lead a direct injurious action upon the nervous substance, at least in the groups of cases which he reports, than he is to emphasize the action of lead upon the bloodvessels, with consequent changes in the spinal cord. In the microscopical sections of cords exhibited the lesions have the general characters of systemic disease, and it does not seem at all likely that disease of this character can be dependent upon primary alterations in the bloodvessels or the circulation. Herter, in my laboratory, has repeated and extended the experiments of Ehrlich and Brieger, showing that temporary anæmia of the cord, produced by compression of the abdominal aorta in rabbits, is followed by changes first in the gray matter. If, therefore, we are warranted in supposing that poisoning with lead is a factor in the production of the diseases of the spinal cord studied by Dr. Putnam, I should be inclined to assign to the lead an injurious influence directly upon the nervous substance, rather than to regard lesions of this character as consecutive to alterations in the circulation, although such, we know, may be caused by lead.

DR. JAMES J. PUTNAM: I have listened with great attention and respect to the criticism of Dr. Welch. I, perhaps, did not succeed in making myself quite clear as regards the view that I take of the case. It seemed to me that the facts warranted the opinion that we had two sets of lesions, more or less distinct. In the first place, a systemic sclerosis which had been present for at least two years before death, and may very likely, at first, not have been associated with any marked change in the nutrition of the gray matter. In the second place, we have the signs of a subacute process in, and especially around, the sclerosed tract, and in connection with that, we have extensive disintegration of the gray matter, especially in the dorsal region, so that there the nerve cells, then, have largely disappeared, while in the lumbar

region they are reduced in number and highly degenerated. Then, again, we have changes in the anterior nerve roots corresponding with those of the cord. That is to say, the anterior nerve roots in the cervical region are practically healthy, while in the dorsal and lumbar regions they are much diseased. The posterior nerve roots, to be sure, are also more diseased in the dorsal and lumbar regions.

My view is, that this system sclerosis may or may not have been due to lead, but, at any rate, was not of anæmic origin, while the subacute changes in the neighborhood of the sclerosed tracts and in the dorsal gray matter may have been anæmic in origin, and, possibly, indirectly due to lead. In a former paper I presented a number of cases suggesting the idea that lead might cause a system sclerosis. I did not dwell upon that point in this paper, because the evidence was not sufficiently convincing. I was, therefore, willing to admit that other causes might be the efficient ones.

As regards the assumption that the changes in the lateral columns might be of vascular [anæmic] origin, in spite of the fact that acute anæmia due to closure of the abdominal aorta causes degeneration in the anterior gray matter and its derivative tracts, I thought this justifiable in view of the impairment of nutrition of the long tracts, due to the sclerosis, which made them unnaturally sensitive to partial failure of their blood-supply.

I should like to say a single word more, and that is, that we cannot but believe that, whatever the obscure lesions of chronic lead-poisoning are, that there are such lesions, and that lead does cause many symptoms which we do not readily recognize.

Moreover, I have recently had strong reason to believe that the community is exposed more than we think, not only to lead, but to arsenic. I have recently had the urine of patients presenting no characteristic symptoms of disease carefully examined for arsenic in twenty-five cases, and arsenic was found in about one-third, usually in small amount, but sometimes in sufficiently large quantities to give a strong reaction. In one or two cases, the discovery of the arsenic has led to the recognition of the symptoms of what I think to be pretty unmistakable arsenical poisoning, which otherwise would not have been strongly suspected.

HOW FAR MAY A COW BE TUBERCULOUS BEFORE HER MILK BECOMES DANGEROUS AS AN ARTICLE OF FOOD.

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THE change of opinion in regard to the infectious nature of tuberculosis has been very marked in the last few years, not among the scientists, but among the people at large. Of course the medical world has, as a rule, accepted the conclusions to be drawn from Villemin's work of twenty-five years ago, and the discovery of the specific cause of the disease by Koch has only added strength to the theories advanced in certain quarters before that time.

The change of opinion spoken of is, after all, hardly a change, but, more properly, an acceptance of the knowledge gained in regard to the disease by the more recent and exact methods of research, and a much wider diffusion of that knowledge. More and more is it the rule that the knowledge of the transmissibility of tuberculosis by means of infected material is recognized among those whom it concerns the most, and nothing but good can come from the diffusion of that knowledge.

It is hardly too much to say that proper methods of management of tuberculosis, both in human beings and in animals, involve more important interests—pecuniary as well as vital—than any other subject that engages the attention of medical men. It is well known that one-seventh of the human race, approximately, perish from this disease, and when we acknowledge to ourselves, as a fair review of the evidence at hand must force us to do, that most, if not all, of this loss is preventable, our duty is plain before us. That is, never to cease speaking of it, never to give up trying to reconcile the money interests of man with his own welfare, and to do all in our power, by the collection of clinical and experimental evidence, to make the case complete.

The work showing the etiological relationship of the bacillus of tuberculosis to the disease was, to all intents and purposes, complete upon the publication of Koch's monograph upon the subject. Nothing more in the way of proof was actually needed, and, indeed, very little has been furnished. At the same time, confirmatory evidence was demanded by some who had and many who had not access to the original details, and this confirmatory evidence has been furnished in such overwhelming amount that it is to-day but a waste of time to repeat, what is accepted the scientific world over, that in the organism described by Koch we have the specific cause of this pathological change, and that without its activity we do not have tuberculosis in any form or under any conditions.

An imperfect understanding of the nature of bacteria in general, and of this organism in particular, has led to many attempts to arrest the pulmonary form of the disease it produces by therapeutic measures, most of which would have been seen to be useless at the outset, if a knowledge of the problem had been complete. It is not upon drugs or mechanical means that our reliance should be placed in attempting to stamp out this scourge of civilized man. Our attention must be turned in the direction of proper preventive measures, and until the necessity for this is impressed upon physicians in general, and by them upon the people at large, so that the preventive measures suggested after mature deliberation will be complied with, but little can be effected, and the knowledge gathered after so much hard labor must be considered as wasted for the time being.

In order to the suggestions upon which the stamping out of tuberculosis must depend, there is necessary a large amount of investigation into the methods by which it spreads, and by which the virus is carried from person to person. Among these methods are undoubtedly the excreta—more especially the sputum—from persons affected with the disease; the excreta are carelessly treated and scattered broadcast for the injury of persons susceptible but not previously affected. The methods of distribution in this way, and the behavior of the bacillus of tuberculosis outside of the body, have been well and recently treated by Cornet (*Zeit. f. Hyg.*, Bd. v. S. 191, 1888). Other methods of distribution are of importance, however, and until within a few years have not received attention from the medical profession at all commensurate with their value. These methods of infection are

those arising from the ingestion of food materials coming from the domestic animals, especially the flesh and milk of cattle.

In Koch's *Etiology of Tuberculosis* he uses the following expressions:

"Since by far the greatest number of cases of tuberculosis begin in the lungs, it is to be supposed that the infection in all these cases has taken place in the manner just suggested—by the inhalation of phthisic sputum dried and made into dust. The second principal source for the tubercle-bacilli, viz., tuberculosis of the domestic animals, appears not to have anything like the importance of the phthisic sputum. The animals, as is well known, produce no sputum, so that during their life no tubercle-bacilli get from them into the outer world by means of the respiratory passages. Also in the excrement of tuberculous animals the bacilli appear to be only exceptionally present. On the contrary, it is a fact that the milk of tuberculous animals can cause infection.

"With the exception of this one way, therefore (*i. e.*, through milk), the tuberculous virus can only have effect after the death of the animal, and can only cause infection by the eating of the meat. The same conditions hold for the milk of cows suffering from 'perlsucht.' Before all things, if infection is to take place, it is necessary that the milk contain tubercle-bacilli; but this appears to be the case only when the milk-glands themselves are affected with the disease. This explains at once the contradictions in the statements of various authors, who have made feeding experiments with the milk from cows suffering from 'perlsucht.' If infection from tuberculous animals does not appear to be frequent, it must by no means be underrated."

This caution is one which was necessary at the time it was written, and its repetition is as necessary now as ever. What conclusions may be reached in regard to its *extreme* importance, are well shown by the statistics collected and presented by Dr. Brush before the New York Academy of Medicine, on April 29, 1889 (*Boston Med. and Surg. Journal*, cxx. p. 467, *et seq.*). In this paper the author states that after several years of close study of the affection, including a consideration of all accessible statistics, and the habits of the people among whom it prevails, he has arrived at the conclusion that the only constantly associated factor is found in the in-bred bovine species. If a community was closely connected with in-bred dairy cattle, tuberculosis prevailed, and, *vice versâ*, if there were no in-bred dairy cattle there was no tuberculosis. In the discussion following this paper many objections were raised. Dr. Brush went on to say that he believed that the disease was originally derived from the bovine species.

He did not believe that less than fifty per cent. of all dairy cattle were affected with it, while the statistics he had quoted showed that wherever there was a race of people without cattle phthisis was unknown. He believed, furthermore, that if all the cattle in this country were to be killed, the disease would finally die out entirely here.

Such statements as these are a revelation to the generality of practitioners, and may seem to be somewhat forced, but they certainly indicate, together with the statistics upon which they are based, the existence of a greater danger than has been fairly realized. That the danger from the consumption of milk coming from cows affected with tuberculosis has been understood by individuals at least, and that, too, before the announcement of Koch's discovery, is very well shown by extracts from a letter which I take the liberty of quoting here. The gentleman writing it is a veterinarian in practice in Providence, R. I., and the observations were made and the advice given more than ten years ago. That portion of his letter bearing upon the subject in hand is as follows:

"Mr. W., June 15, 1878, called me to see a white and red cow. Coughs and is short of breath and wheezes. Pulse 60; respiration 14, and heavy at the flanks; temperature 104°. Diminished resonance of right lung, but increased in part of the same. Emphysematous crackling over left lung and dulness on percussion. Diagnosed a case of tuberculosis and advised the destruction of the animal.

"*Dec.* 12. Cow in a cold rain a few days ago for about two hours. Milk still more diminished than at a visit made on September 25. Again advised the destruction of the cow. Family still using the milk. Respiration 20; pulse 85; temperature 104.6°.

"*Feb.* 22, 1879. Temperature 104.8°; respiration 26; pulse 68. Losing flesh fast. Milk still in small quantities. Advised, as before, to destroy the animal and *not to use milk.*

"*May* 30. Called in a hurry to see cow. Is now as poor as could be. No milk for a week. Pulse 80; respiration 40; temperature 106°. The cow died in about three hours. Autopsy made fourteen hours after death. Lungs infiltrated with tuberculous deposit. Weight of thoracic viscera 43.5 pounds. Tuberculous deposits found in the mediastinum, in the muscular tissues, and in the mesentery, spleen, kidneys, udder, intestines, pleura, and one deposit on the tongue. The inside of the trachea was covered with small tubercles.

"In August, 1879, the baby was taken sick, and died in about seven weeks. On post-mortem of the child there was found meningeal tuberculosis—deposits all over the coverings of the brain and some in the lung.

"In 1881 a child, about three years old, died with, as it was called, tuber-

culous bronchitis. And in 1886, a boy, nine years old, who for three or four years had been delicate, died with consumption—'quick,' as it was called.

"So far as known, the family on both sides have never before had any trouble of the kind, and the parents were both rugged and healthy people, and so were the grandparents—one now being alive and sixty-eight years old, and the other dead at seventy-eight."

Of course there is much room for criticism, if these cases be quoted as carrying out an exact clinical experiment, and no one can say that the occurrence of the three deaths in the same family was anything more than a coincidence. At the same time it must be acknowledged that they offer very solid suggestions for consideration, and that the light thrown upon the disease by the investigations of recent years make the advice of the veterinarian to "kill the cow and stop using the milk" much more sound than it appeared to the minds of the medical gentlemen who "laughed" at him at the time it was given.

It is my hope within the coming year to collect a series of clinical observations which will be of interest and some service in elucidating the question of how many cases of tuberculosis occur which produce suspicion in the minds of medical or veterinary attendants of having an origin in the milk from infectious cows. It is upon this question of possible danger from the domestic animals—especially cattle—that much recent work has been done, but the subject has been by no means exhausted. If there is danger to human beings from the widespread existence of tuberculosis among cattle, some sort of restrictive measures must be taken, by means of which this danger can be lessened. At the same time legislation calling for so much pecuniary loss as would be the case if the present supply of tuberculous cattle were to be destroyed, can only be asked for with a backing of as much carefully gathered scientific evidence as can be obtained, and it is the part of preventive medicine and the experimental method to furnish some of this evidence.

Through the liberality and broad-mindedness of an association of gentlemen in Boston, it is possible to present the results of certain experiments undertaken to determine the question which is expressed in the title of this paper. "How far may a cow be tuberculous before her milk becomes dangerous as an article of food?" is an extremely important point to decide. If it be considered already settled and Koch's dictum be accepted, that there is no danger in the milk, if the

mammary glands be not affected, then there remains only for the veterinary surgeon to determine the existence of such lesions, and restrictive measures can go no further. If, however, the milk from cows with no visible lesion of the lacteal tract, be shown to contain the specific virus of the disease in a not inconsiderable number of cases, and if this milk be shown to possess the power of producing the tuberculous process upon inoculation in small quantities and in feeding experiments carried out with every possible precaution, then restrictive measures must have a far wider scope, and be carried on from an entirely different standpoint than has heretofore been considered necessary.

It is familiar to most of us that little importance has been attached to this question—the danger of milk from tuberculous cows with no lesions of the udder—for the reason that many experiments have been made with negative results, and because *à priori* reasoning would seem to indicate the absence of such danger; because tuberculosis is not a disease like anthrax, in which the specific poison is to be found in all parts of the system and is carried from one place to another by the blood-stream. Koch's assertion that the milk from cows affected with tuberculosis is dangerous only when the udder is involved, appears to be based upon theoretical considerations rather than practical work in this especial direction. It has been widely accepted, however, and the weight of his name has caused the assertion to be repeated many times with but few attempts to verify its correctness.

The increased attention that has been paid to the disease among cattle, and the suspicions that have been aroused that tuberculosis among the domestic animals is a more frequent cause of its appearance among men than has been supposed, have made a careful investigation of this point imperatively necessary. With the exception of a few successful experiments by Bollinger (*Deutsch. Zeit. f. Thiermed.*, Bd. xiv. S. 264) and Bang (*Ibid.*, Bd. xi. S. 45, 1885), no evidence of great value is to be adduced. These authors, as well as Tschokke (quoted by Bollinger), bring out isolated cases showing successful inoculation experiments with the milk from tuberculous cows with no disease of the udders, but the experiments are so few in number that they cannot be accepted as furnishing more than a probability, and extremely critical persons might be justified in ascribing the results to contamination.

Bang (*Congrès pour l'étude de la Tuberculose*, 1, p. 70, 1888) gives

new results. Examining twenty-one cases of cows affected with general tuberculosis but with no signs of disease in the udder, he found but two whose milk showed virulent qualities upon inoculation in rabbits. He concludes that since the cows experimented with were in advanced stages of the disease and yet showed such slight virulent properties in their milk, the danger from cows in less advanced stages is much less. And this conclusion he thinks is borne out by experiments with milk drawn from eight women affected with tuberculosis; specimens were used from all for inoculation and none were found to be virulent. He draws the conclusion, therefore, that it is not necessary to consider all milk dangerous coming from tuberculous cows, but that it should always be *suspected*, because no one can say when the udder will be diseased, and because, without this, the milk from tuberculous cows contains the virus in rare cases. I shall endeavor to show that it is not at all rare for such milk to contain the virus. Galtier also (*loc. cit.*, p. 81) has given the result of certain experiments with milk coming from tuberculous cows, but he says that

"certain experimenters claim to have established the virulence of milk coming from animals whose udders appeared to be normal and free from any lesions; the greater number, and I am one of them, have merely encountered virulence in milk after the udder had become tuberculous. However, as a beginning tuberculosis of the udder is an extremely difficult thing to recognize, especially during the life of the animal, the milk should be considered dangerous which comes from any animal affected, or suspected of being affected, with tuberculosis."

I shall endeavor to show that this view of the case is justified by something more than probabilities.

In the *Deutsch. Arch. für klin. Med.*, Bd. xliv. S. 500, Hirschberger reports the results of an experimental research upon the infectiousness of the milk of tuberculous cows, in which—following out Bollinger's work—he attempts to settle, 1st, whether the cases are rare in which tuberculous cows give an infectious milk, and 2d, whether the milk is infectious only in cows with general tuberculosis, or whether it is also infectious when the disease is localized. He made the trials of the infected milk by injection into the abdominal cavity of guinea-pigs with the usual precautions. His results were as follows:

1. Milk was used five times from cows affected with a very high degree of general tuberculosis in all the organs.

2. Milk was used six times from cows with only a moderate degree of disease.

3. Milk was used nine times from cows in which the disease was localized in the lung.

From these twenty cases the milk was proven to be infectious in eleven. The percentage of positive results in the animals when arranged in accordance with the three groups above given was 80 per cent. in the first group (milk from cows in a very advanced stage of the disease), 66 per cent. in the second group, and 33 per cent. in the third. He found the bacilli in only one of the specimens of the milk, and considers that this, therefore, shows that the inoculation experiments are the more certain guide as to whether the milk is infectious or not. These results are extremely interesting, although they do not lay as much stress as do mine upon the presence or absence of lesions of the lacteal tract.

The experiments which I am able to report have been made possible by the liberality of the Massachusetts Society for Promoting Agriculture, which became interested in the question some time ago, and has put it in my power to carry them on. They have given everything in the way of pecuniary and moral support that the work has required; my own part has been that of general director, and I have had associated with me during the whole time the Society's veterinarian, Austin Peters, D.V.S. For the last year I have also had the very valuable aid of Dr. Henry Jackson and Langdon Frothingham, M. D. V. All of the inoculation experiments and most of the microscopic work have been done in the bacteriological laboratory of the Harvard Medical School, some of the microscopic work at the Society's laboratory in Boston, whilst the feeding experiments have been done and the experimental animals have been kept at a farm in the country devoted to this especial purpose, and situated among the healthiest possible surroundings. Nothing has been set down as the result of microscopic observation that I have not myself verified, and every portion of the work has been carried out under the most exacting conditions and with every possible precaution against contamination.

Before the farm buildings were used at all they were thoroughly cleaned from top to bottom. Every portion of old manure was carted away, as well as all the old earth. The whole of the woodwork was scrubbed and then washed with corrosive sublimate solution (1 : 1000)

and finally whitewashed, and every care was taken to secure good drainage and free ventilation. The result and effectiveness of all this have been demonstrated by the fact that every animal brought to the place made a most marked improvement in its general condition, while some of them even went so far as to appear to get well.

In deciding whether the milk from any cow affected with tuberculosis is dangerous, when the udder shows no lesion, the first point is to see whether the milk contains the infectious principle or not. In this case, of course, that infectious principle is the bacillus of tuberculosis and attention was turned to that for some time. The observations have been carried on over a long space of time, and were made as follows: The milk was taken from the cow in the morning—or evening, as the case might be—the udders and teats having just been thoroughly cleansed. The receptacle was an Erlenmeyer flask, stoppered with cotton-wool and thoroughly sterilized by heat. The specimen was taken at once to the laboratory, there placed in conical glasses, with ground-glass covers—the whole of these having been carefully cleansed beforehand—and then allowed to stand in a clean refrigerator for twenty-four to forty-eight hours, and sometimes for seventy-two hours. At the end of that time from ten to twenty cover-glass preparations were made from various parts of the milk or cream. These were stained after Ehrlich's twenty-four hour method, with fuchsin and methylene-blue as a contrast color, and then searched with an immersion lens. The result is as follows:

I. *Results of Examinations of Milk for Bacilli of Tuberculosis.*[1]

1. Dutton cow, December 14, 1887. Temp. 103°; no signs in udder; emaciation. *Butcher's autopsy:* tuberculosis of both lungs, both pleuræ, pericardium, and mediastinum.

2. J. C. R., December 17, 1887. Healthy in May; December 17th, enlarged submaxillary lymphatics; dull and diminished respiratory murmur on right side with cough. Result negative. No autopsy.

3. J. C. R., December 17, 1887. Healthy in May; December 17th, enlarged submaxillary lymphatics. Result negative. No autopsy.

4. J. C. R., December 17, 1887. Healthy in May; December 17th, enlarged submaxillary lymphatics; dull in left lung, lower portion. Result negative. No autopsy.

5. J. C. R., December 17, 1887. Healthy in May; December 17th, enlarged submaxillary lymphatics. Result negative. No autopsy.

6. J. C. R., December 17, 1887. Healthy in May; December 17th, much enlarged submaxillary lymphatics. Result negative. No autopsy.

7. J. C. R., December 17, 1887. Healthy in May; Dec. 17th, slightly enlarged submaxillary lymphatics. Result negative. No autopsy.

8. J. C. R., December 17, 1887. Healthy in May; December 17th, slightly enlarged submaxillary lymphatics. Result negative. No autopsy.

9. F. L. A., December 19, 1887. Result: *positive.* Autopsy, December 22, 1887: Tuberculosis of lungs, pleura, liver, spleen, peritoneum, ovaries, and mediastinal lymphatic glands; udder was healthy.

[1] Ehrlich stain was used in all of these examinations.

10. J. C. R., December 1, 1888. Symptoms same as in No. 2. No autopsy.

11. J. C. R., December 1, 1888. Symptoms same as in No. 3. No autopsy.

12. Mrs. B., December 22, 1887. Enlarged submaxillary lymphatic glands; udder healthy. No autopsy.

13. McLean Asylum, June 23, 1888. Cough at times; udder indurated. No result reached. Sample of milk spoiled, and examination not completed.

14. McLean Asylum, June 23, 1888. Cough at times; udder indurated. No result reached. Sample of milk spoiled, and examination not completed.

15. McLean Asylum, June 23, 1888. Cough at times; udder indurated. No result reached. Sample of milk spoiled, and examination not completed.

16. H. A. D., February 8, 1888. Cough; rough inspiration over right lung; posterior quarters of udder indurated. Sample of milk spoiled, and examination not completed.

17. Cow A, February 18, 1888, milk taken from the posterior quarters of udder. Submaxillary glands enlarged; nodules in both posterior quarters of udder; comes from a herd in which tuberculosis exists; general appearance good. Result *positive*. January 9, 1889, killed: Right lung slightly nodulated; very large lymphatic gland in inguinal region above the udder; *microscope* showed bacilli in lungs; sections from udder showed old mammitis, *no tuberculosis*.

18. Cow A, March 10, 1888. Symptoms and post-mortem same as in No. 17. } Result
19. Cow A, June 2, 1888, morning's milk. Symptoms and post-mortem as in No. 17. } nega-
20. Cow A, November 8, 1888, morning's milk. Symptoms and post-mortem as in No. 17. } tive.

21. Cow B, February 29, 1888. Pulmonary tuberculosis, with other organs probably involved; cough and emaciation; udder healthy. Result negative. July 6, 1889, killed: General tuberculosis involving lungs, pleura, liver, peritoneum, capsule of spleen, both ovaries, uterus (internal face), and lymphatic glands; udder scirrhous, but no tubercles. *Sections* showed bacilli in lungs, *no bacilli* in udder, and no tuberculosis.

22. Cow B, March 10, 1888. Symptoms, result, and post-mortem same as in No. 21.

23. Cow B, April 3, 1888. " " " " " " "

24. Cow B, March 25, 1888. " " " " " " "

25. Cow B, June 1, 1888 (evening). " " " " " " "

26. Cow B, June 2, 1888 (morning). " " " " " " "

27. Cow C, February 29, 1888. Posterior right quarter of the udder nodulated; no other symptoms. Result negative. No autopsy.

28. Cow C, March 10, 1888. Symptoms, result, and post-mortem same as in No. 27.

29. Cow E, March 28, 1888. Enlarged submaxillary glands; crepitus on right side, and dulness over lower part of right lung; slight cough. Not killed in September, 1889.

30. Cow E, November 8, 1888. Symptoms, result, and post-mortem same as in No. 29.

31. Cow H, March 28, 1888. Submaxillary lymphatic glands enlarged; probable disease of both lungs; left hind quarter of udder nodulated. Result negative. April 10, 1889, killed: A few nodules in the left lung, and a few enlarged and cheesy mesenteric glands, with a few miliary nodules in the walls of the small intestine; udder slightly fibrous; microscope showed bacilli in the lungs and glands; the udder not tuberculous.

32. Cow H, November 8, 1888. Symptoms, result, and post-mortem same as in No. 31.

33. Cow D, April 10, 1888. Submaxillary lymphatic glands enlarged; crepitus over lower part of right lung (probably pleuritic); no dulness on percussion. Result negative. Not killed in September.

34. Cow D, November 8, 1888. Submaxillary glands enlarged; crepitus over lower part of right lung (probably pleuritic); dulness on percussion. Result *positive*. Not killed in September, 1889.

35. Cow D, December 11, 1888 (milk from nodulated teats). Submaxillary lymphatic glands enlarged; crepitus over lower part of right lung (probably pleuritic); no dulness on percussion. Result negative. Not killed in September, 1889.

36. Slocum's cow, April 19, 1888. Probable general tuberculosis. No autopsy.

37. Cow G, April 20, 1888. Submaxillary lymphatic glands enlarged; crepitus and dulness in lower part of right lung; coughs a little. Result negative. Not killed in September, 1889.

38. Cow G, November 8, 1888. Symptoms, result, and post-mortem same as in No. 37.

39. Cow F, November 8, 1888. Submaxillary lymphatics enlarged; crepitus and dulness over lower part of right side; coughs frequently. No result. August 21, 1889, killed: Nodules in both lungs, and large cavity in posterior lobe of right lung; a number of small nodules in liver; a few in the omentum, some in the walls of the small intestine; some cheesy deposit on the ribs on right side, with pleuritic adhesions. Udder appeared healthy, except one quarter which was slightly scirrhous, and contained a few small yellow spots size of a pin's head.

40. Cow I, November 8, 1888. Submaxillary glands enlarged; dulness on percussion over both lungs; crepitus on right side; cough. Result *positive*. Not killed in September, 1889.

41. Cow J, November 8, 1888. Submaxillary lymphatics enlarged; both lungs involved; cough. Result negative. January 9, 1889, killed: Tuberculosis of right lung and liver, and enlarged mediastinal gland; liver contained echinococcus cysts. *Microscope* showed bacilli in lung, liver, and mediastinal gland.

42. "Brownie," November 26, 1888. No symptoms. Result *positive*. Post-mortem, S. F. W.:

"External lymphatics enlarged, those in submaxillary region have undergone a caseous change. *Lungs* in all stages of phthisis. *Pleura* covered with deposits. *Mesenteric glands* enlarged. *Ovaries* tuberculous. *Udder* scirrhous but with no apparent tuberculosis. No specimens sent in for microscopic examination."

43. J. F. W., November 26, 1888. No symptoms. Result negative. Post-mortem, J. F. W.: "External lymphatics enlarged; lungs broken down in places, and in different stages of tuberculosis; mediastinal lymphatic glands cheesy; other organs apparently normal." No specimens sent in for microscopic examination.

44. Cow D, January 11, 1889 (first of milking). Symptoms same as in No. 33. Not killed in September, 1889.

45. Cow D, January 11, 1889 (last of milking). Symptoms same as in No. 33. Not killed in September, 1889.

46. Cow E, January 16, 1889 (first of milking). Symptoms same as in No. 29. Not killed in September, 1889.

47. Cow E, January 16, 1889 (last of milking). Symptoms same as in No. 29. Not killed in September, 1889.

48. Cow F, January 18, 1889 (first of milking). Symptoms same as in No. 39. Result negative. Post-mortem same as in No. 39.

49. Cow F, January 18, 1889 (last of milking). Symptoms same as in No. 39. Result negative. Post-mortem same as in No. 39.

50. Cow G, January 21, 1889 (first of milking). Symptoms same as in No. 37. Not killed in September, 1889.

51. Cow G, January 21, 1889 (last of milking). Symptoms same as in No. 37. Not killed in Seeptember, 1889.

52. Cow H, January 26, 1889 (first of milking). Symptoms same as in No. 31. Post-mortem same as in No. 31.

53. Cow H, January 26, 1889 (last of milking). Symptoms same as in No. 31. Post-mortem same as in No. 31.

54. Cow J, January 30, 1889 (first of milking). Symptoms same as in No. 40. Not killed in September 1889.

55. Cow J, January 30, 1889 (last of milking). Symptoms same as in No. 40. Not killed in September, 1889.

56. Cow M, February 2, 1889 (first of milking). No cough; breathes badly; nodules in various parts of the skin. Result negative. Not killed in September, 1889.

57. Cow M, February 2, 1889 (last of milking). See No. 56.

58. Cow L, March 5, 1889 (first of milking). Cough; no other symptoms noted. Not killed in September, 1889.

59. Cow L, March 5, 1889 (last of milking). See No. 58.

60. Cow O, March 6, 1889 (first of milking, *cream*). General tuberculosis (no special description given). Result *positive*. August 21, 1889, killed: Lungs full of cheesy degenerated nodules; four white spots in the liver; two inguinal lymphatic glands enlarged and cheesy from directly above the udder; left posterior quarter of the udder slightly scirrhous. *Microscope* showed bacilli in lungs and lymphatics, udder negative.

61. Cow O, March 6, 1889 (first of the milking, *sediment*). General tuberculosis (no special description given). Result negative. Post-mortem same as in No. 60.

62. Cow O, March 6, 1889 (last of milking, *cream*). General tuberculosis (no special description given). Post-mortem same as in No. 60.

63. Cow O, March 6, 1889 (last of milking, *sediment*). General tuberculosis (no special description given). Result *positive*. Post-mortem same as No. 60.

64. Cow P, March 6, 1889 (cream before death). General tuberculosis (no special description given); udder hard but not diseased. Result *positive*. March 6, 1889, killed: Lungs a mass of tuberculous deposits, as well as the mediastinal lymphatics, visceral layer of the pericardium, and inside of ribs, mesentery, diaphragm, and peritoneum. A few nodules in the liver, none in the spleen; inguinal lymphatics above the udder itself not diseased. Microscope showed the bacilli in all the organs and in the ribs.

65. Cow P, March 6, 1889 (milk before death). General tuberculosis (no special description given); udder hard but not diseased.

66. Cow P, March 6, 1889 (cream after death). General tuberculosis (no special description given); udder hard but not diseased. Result *positive*.

67. Cow P, March 6, 1889 (milk after death). See No. 66.

68. Cow P, March 11, 1889 (first of milking, cream). Symptoms same as in No. 33. Result *positive*. Not killed in September, 1889.

69. Cow P, March 11, 1889 (first of milking, milk). Symptoms same as in No. 33. Not killed in September, 1889.

70. Cow P, March 11, 1889 (last of milking, cream). Symptoms same as in No. 33. Not killed September, 1889.

71. Cow P, March 11, 1889 (last of milking, milk). Symptoms same as in No. 73. Result *positive*. Not killed in September, 1889.

72. Cow E, March 14, 1889 (first of milking, cream). Symptoms same as in No. 29. Not killed in September, 1889.

73. Cow E, March 14, 1889 (first of milking, milk). Symptoms same as in No. 29. Not killed in September, 1889.

74. Cow E, March 14, 1889 (last of milking, cream). Symptoms same as in No. 29. Not killed in September, 1889.

75. Cow E, March 14, 1889 (last of milking, milk). Symptoms same as in No. 29. Result *positive*. Not killed in September, 1889.

76. Cow F, March 16, 1889 (first of milking, cream). Symptoms same as in No. 39. Post-mortem same as in No. 39.

77. Cow F, March 16, 1889 (last of milking, cream). Symptoms same as in No. 39. Post-mortem same as in No. 39.

78. Cow G, March 16, 1889 (first of milking, cream). Symptoms same as in No. 37. Not killed in September, 1889.

79. Cow G, March 20, 1889 (last of milking, cream). Symptoms same as in No. 37. Not killed in September, 1889.

80. Cow H, March 23, 1889 (first of milking, cream). Symptoms same as in No. 31. Result negative. Post-mortem same as in No. 31.

81. Cow H, March 23, 1889 (last of milking, cream). Symptoms same as in No. 31. Result negative. Post-mortem same as in No. 31.

82. Cow I, March 28, 1887 (first of milking, cream). Symptoms same as in No. 40. Result *positive*. Not killed in September, 1889.

83. Cow I, March 28, 1889 (last of milking, cream). Symptoms same as in No. 40. Result *positive*. Not killed in September, 1889.

84. Cow O, March 30, 1889 (first of milking, cream). Symptoms same as in No. 60. Post-mortem same as in No. 60.

85. Cow O, March 30, 1889 (last of milking, cream). Symptoms same as in No. 60. Post-mortem same as in No. 60.

86. Cow M, April 4, 1889 (first of milking). Symptoms same as in No. 56. Not killed in September, 1889.

87. Cow M, April 4, 1889 (last of milking). Symptoms same as in No. 56. Not killed in September, 1889.

88. Cow Q, May 9, 1889 (first of milking). Cough more or less for one year; two spots of dulness over right lung; probably general tuberculosis. August 21, 1889, killed: Few miliary nodules in left lung; upper part of posterior lobe collapsed, and the remainder emphysematous; one of middle lobes of right lung a mass of miliary nodules. Enlarged lymphatic in inguinal region above the udder; a few nodules in the liver; udder appeared normal.

89. Cow Q, May 9, 1889 (last of milking). Symptoms same as in No. 88. Post-mortem, same.

90. Slocum's cow, June 8, 1889 (first of milking, milk). Breathing is rapid and labored; the lymphatic glands slightly enlarged; poor in flesh; mammitis in left hind quarter of udder. No autopsy.

91. Slocum's cow, June 8, 1889 (first of milking, cream). Symptoms same as in No. 90. Result *positive*. No autopsy.

92. Slocum's cow, June 8, 1889 (last of milking, milk). Symptoms same as in No. 90. No autopsy.

93. Slocum's cow, June 8, 1889 (last of milking, cream). Symptoms same as in No. 90. Result *positive*. No autopsy.

94. Saunder's cow, June 11, 1889 (first of milking, milk). Cough at times, but general health seems to be good. No autopsy.

95. Saunder's cow, June 11, 1889 (first of milking, cream). Cough at times, but general health seems to be good. No autopsy.

96. Saunder's cow, June 11, 1889 (last of milking, milk). Cough at times, but general health seems to be good. No autopsy.

97. Saunder's cow, June 11, 1889 (last of milking, cream). Cough at times, but general health seems to be good. No autopsy.

98. Mayhew's cow, June 8, 1889 (milk)). Emaciated; cough; enlarged lymphatics in glands; no nodules in udder. Result *positive*. No autopsy.

99. Mayhew's cow, June 8, 1889 (cream). Emaciated; cough; enlarged lymphatics in glands; no nodules in udder. No autopsy.

100. Slocum's cow, June 24, 1889 (milk). No autopsy.

101. Slocum's cow, June 24, 1889 (cream). No autopsy.

102. Cow R, July 10, 1889 (first of milking, milk). April 22, 1889, cough; dulness over left lung; tuberculosis. August 21st, killed: Tuberculous deposits in posterior lobes of both lungs; a few small nodules in capsule of spleen; enlarged gland just above the udder; one kidney slightly injected; a few nodules in liver; udder slightly scirrhous. Between four and five months with calf; membranes and umbilical cord studded with nodules; fœtus said to be healthy. Microscope, no results.

103. Cow R, July 10, 1889 (last of milking, cream). Symptoms and post-mortem same as in No. 102.

104. Cow D, July 13, 1889 (first of milking, milk). Symptoms same as in No. 33. Not killed in September, 1889.

105. Cow D, July 13, 1889 (last of milking, cream). Symptoms same as in No. 33. Not killed in September, 1889.

106. Cow E, July 19, 1889 (first of milking, milk). Symptoms same as in No. 29. Not killed in September, 1889.

107. Cow E, July 19, 1889 (last of milking, cream). Symptoms same as in No. 29. Not killed in September, 1889.

108. Cow G, July 23, 1889 (first of milking, milk). Symptoms same as in No. 37. Not killed in September, 1889.

109. Cow G, July 23, 1889 (last of milking, cream). Symptoms same as in No. 37. Not killed in September, 1889.

110. Cow F, July 25, 1889 (first of milking, milk). Symptoms and post-mortem same as in No. 39.

111. Cow F, July 25, 1889 (last of milking, cream). Symptoms and post-mortem same as in No. 39.

112. Cow F, July 25, 1889 (first of milking, cream). Symptoms and post-mortem same as in No. 39.

113. Cow F, July 25, 1889 (last of milking, milk) Symptoms and post-mortem same as in No. 39.

114. Cow L, July 25, 1889 (first of milking, milk). Symptoms same as in No. 58. Not killed in September, 1889.

115. Cow L, July 25, 1889 (first of milking, cream). Symptoms same as in No. 58. Not killed in September, 1889.

116. Cow L, July 25, 1889 (last of milking, milk). Symptoms same as in No. 58. Not killed in September, 1889.

117. Cow L, July 25, 1889 (last of milking, cream). Symptoms same as in No. 58. Not killed in September, 1889.

A study of these results shows some extremely interesting facts. By it, it appears that we prepared for examination in the way spoken of above, one hundred and seventeen sets of cover-glasses from as many different samples of milk. Of these specimens three spoiled, *i. e.*, turned sour or acid before the examination was completed, and must be rejected, leaving, therefore, one hundred and fourteen samples of milk of which the examination was completed. These samples were obtained from thirty-six different cows, all of them presenting more or less distinct signs of tuberculosis of the lungs or elsewhere, but none of them having marked signs of disease of the udder of any kind.

Of these samples of milk there were found *seventeen* in which the bacilli of tuberculosis were distinctly present; that is to say, the *actual virus was seen in* 31.5 per cent. of the samples examined (36 : 114=31.5). These seventeen samples of infectious milk came from ten different cows, showing a percentage of *detected* infectiousness of 27.7 (10 : 36=27.7). These results are exceedingly interesting, it seems to me, and I confess I am surprised at the size of the percentage named. Not because I had not expected to find the bacilli —I have been convinced for several years that persistent search would show their presence in such cases as those that are here recorded—but

because the amount of dilution to which the organisms must be subjected, diminished immensely the chance of their being found at all. In no case have they been seen in large numbers, but equally in no case has a diagnosis been made where there was the slightest doubt of the appearance under the microscope.

The large number of cases in which these organisms have been found seems to me to indicate their presence in a still greater proportion of cases, if only a sufficiently thorough examination of all the milk could be made. This, of course, is out of the question, but the results here given seem to establish, beyond a doubt, the fact that milk coming from cows with no definite lesion of the udder may contain the infectious principle of tuberculosis, if the disease be present in other portions of the body of the animal. Also, that this presence of the infectious principle is not merely a scientific *possibility* but an actual *probability*, which we should be thoroughly aware of and alive to. Other interesting facts shown are these: that the cream after rising is quite as likely to be infectious as the milk, because the bacilli were found in the milk nine times after the cream had risen, and in the cream eight times after it had separated from the milk.

In regard to the constancy of the occurrence of the bacilli in the milk: in two of the ten cows in whose milk the bacilli were found, but one sample of the milk was examined; and the bacilli were found in one sample out of several examined at different times, in two cases. In the remaining six cows, bacilli were found two or more times in different samples of the milk. So that, as far as they go, these results seem to indicate that the bacilli are present with a fair degree of constancy. At the same time it should not be surprising if one examination was successful and others failed, because of the chances against success, owing to dilution, which were spoken of above. In nine of the seventeen cases the time of the milking and the portion of the milk used were noted; that is to say, a sample was taken from the first of the milking, or the last of the milking, and then cover-glasses made from the milk or cream. In these cases bacilli were found in the cream three times, and in the milk four times, from the first of the milking; in samples from the last of the milking, in the cream no times, and in the milk four times; and this too seems to show an interesting point, viz., that the bacilli, if present at all in the udder, are not washed out entirely by the first manipulations of the teats, but

may be supposedly present in any portion of the milk. The converse is also indicated, that the manipulation of the udder in the process of milking does not express the bacilli from the tissue into the latter portion of the milk, but that, as before, they may be supposed to be pretty evenly distributed in all parts of the udder, if they be present at all.

Before going on to consider the results of the inoculation experiments made with various specimens of milk, it may be well to glance at the condition of the cows that have been under our control from the time of the beginning of the experiments until they were killed, or until the date of preparing this paper.

II. *History of Cows used for further Experiment than simple Examination of the Milk.*

1. Cow A, purchased February 16, 1888. Age 10 years, red native. Peabody Poor Farm, from a tuberculous herd; enlarged submaxillary lymphatics; both hind quarters nodulated; calved prematurely several years ago; gives ten to twelve quarts of milk a day. January 9, 1889, killed: Right lung slightly tuberculous; very large lymphatic glands in inguinal region above the udder; the hind quarters of udder were indurated during life. Post-mortem showed a thickening of the walls of the ducts and sinuses, but no tuberculous deposits. Microscope showed bacilli in the lungs; udder negative.

2. Cow B, purchased February 27, 1888. Age 10 years, high grade Jersey. Seen first June, 1887, then was quite tuberculous. February, 1888, pulmonary tuberculosis with probable affection of other organs: coughs and expectorates freely; gives from four to five quarts of milk daily; udder appears healthy. July 6, 1889, killed: General tuberculosis involving lungs, pleura, liver, peritoneum, capsule of spleen, both ovaries, uterus (internal face), and lymphatic glands: the udder scirrhous, but no tubercles; bacilli found in lungs and other organs, but no signs of them in the udder.

3. Cow C, purchased February 28, 1888. Age 10 to 12 years, red native. Diagnosis of tuberculosis uncertain; right hind quarter of udder nodulated; gives eight to nine quarts of milk daily. No autopsy.

4. Cow D, purchased March 22, 1888. Age 11 years, black native with some Dutch blood. Submaxillary lymphatics enlarged; crepitus over lower part of right lung; no dulness on percussion. April 9th, slight nodulation in left hind quarter of udder. No autopsy made up to September, 1889.

5. Cow E, purchased March 22, 1889. Age 12 years, red native. Enlarged submaxillary lymphatic glands; crepitus on right side and dulness on lower part of the right lung; coughs a little occasionally. February 15, 1889, the right hind quarter of udder nodulated. No autopsy up to September, 1889.

6. Cow F, purchased March 22, 1889. Age 11 years, short-horn, red native. Enlarged submaxillary lymphatics; crepitus and dulness on lower part of right side; coughs frequently. August 21, 1889, killed: Nodules in both lungs, and large cavity in posterior lobe of lung; a number of small nodules in the liver, a few in the omentum and in walls of the small intestine; some tuberculous deposit in the ribs on the right side, with pleuritic adhesions; udder appeared healthy, except one quarter was a little scirrhous, and contained a few yellow spots. The microscope showed these to be fat; bacilli in the lungs; udder negative, except one giant-cell with bacilli.

7. Cow G, purchased March 22, 1888. Age 9 years, brindle, white native. Submaxillary lymphatics enlarged; crepitus and dulness over lower part of right lung; coughs a little. No autopsy up to September, 1889.

8. Cow H, purchased March 22, 1888. Age 15 years, red native. Submaxillary lymphatics enlarged; probable disease of both lungs; left hind quarter of udder slightly nodulated. April 10, 1889, killed: A few tubercles in left lung, and a few enlarged cheesy mesenteric glands, with some miliary nodules in the walls of the small intestine. Udder slightly fibrous. Microscope showed bacilli in lungs and glands, but no tuberculosis of the udder.

9. Cow I, purchased March 22, 1888. Age 9 years, red native. Submaxillary lymphatics enlarged; dulness over both lungs, and crepitus on right side; coughs. June 10, 1889, cough rare, and condition very good. July 31, 1888, slight mammitis. No autopsy up to September, 1889.

10. Cow J, purchased April 5, 1888. Red native. Submaxillary lymphatics enlarged, and both lungs involved; coughs. July 9. 1889, killed: Tuberculosis of right lung and liver, and an

enlarged mediastinal gland; echinococci of liver; bacilli in lung and liver under microscope, and in gland; udder healthy.

11. Cow L, purchased March 31, 1889. Supposed to be healthy when bought for another purpose; coughed soon afterward. No autopsy up to September, 1889.

12. Cow M, purchased February, 1889. Age 5 years, Guernsey. Examined in May, 1889: healthy; does not cough, but breathes badly; nodules in various parts of skin, from the size of a pea to a marble. June 10, 1889, many of the nodules under the skin broke, full of bacilli (lupus?). No autopsy made up to September, 1889.

13. Cow N, purchased March 27, 1888. Guernsey. January 9, 1889, killed: A few nodules in lungs and liver; the ovaries dropsical, and some enlarged mediastinal lymphatic glands; bacilli found in lungs, liver, and glands; udder healthy.

14. Cow O, purchased February 21, 1889. Age 8 years, thoroughbred Jersey. General tuberculosis. August 21, 1889, killed: Lungs full of cheesy degenerated nodules; a few white spots in liver; two glands just above udder enlarged and cheesy; left posterior quarter of udder slightly scirrhous; bacilli in lungs and lymphatics; udder negative.

15. Cow P, purchased March 1, 1888. Age 10 years, Jersey. General tuberculosis; udder hard but not diseased; families fed on milk for eight months before purchase. March 6, 1889 killed: General and extensive tuberculosis; lungs a mass of disease, as were the mediastinal lymphatics, visceral layer of the pericardium, and inside of the ribs, the mesentery, diaphragm, and peritoneum; a few nodules in the liver, none in the spleen; inguinal lymphatics above the udder enlarged, but the udder itself was not diseased; bacilli found everywhere, and in the milk; udder negative.

16. Cow Q, purchased April 22, 1889. Age 5 years, thoroughbred Guernsey. Coughed more or less for a year, now a good deal; general tuberculosis. May 8, abscess broke in lung. June 14, general condition good again. August 21, 1889, killed: Few miliary nodules in left lung; upper part of posterior lobe collapsed and the remainder emphysematous; right lung had one of middle lobes a mass of miliary tubercles; enlarged lymphatics in inguinal region above the udder; a few nodules in the liver; udder appeared normal. Microscope: udder negative; other examination not completed.

17. Cow R, purchased April 22, 1889. Age 5 years, high grade Jersey. Cough; dulness over left lung; tuberculosis; gives ten to twelve quarts of milk. August 21, 1889, killed: Tuberculosis in the posterior lobes of both lungs; a few small nodules in the capsule of the spleen; an enlarged inguinal gland just above the udder; one kidney slightly injected; a few nodules in liver; udder slightly scirrhous; between from four and five months with calf; membranes and umbilical cord were studded with nodules, but fœtus appeared healthy. Microscope: udder negative; other examination not completed.

18. Cow S, purchased June 25, 1889. High grade Guernsey. Breathing rapid and jerky; has enlarged inguinal glands; very little cough; mammitis, leaving nodules in udder on July 31st, but August 8th this had disappeared. No autopsy up to September, 1889.

The history of each cow, as far as we have been able to secure it, bears out our assertion, as far as the examinations have gone, that none of the udders was affected with tuberculosis—certainly so far as gross appearances were concerned. This was true, also, in the microscopic appearance of every case but one (No. 6, cow F). In this case the gross appearances in the udder were healthy, except that one quarter seemed to be slightly fibrous, and there were one or two yellow spots which were seen to be made up of fat under the microscope. With a low-power lens only a slight increase of fibrous tissue was observable, and the oil-immersion was put on merely as a matter of routine. One giant cell was discovered containing a number of bacilli, but a careful search failed to show any others, or any signs of change, except the increase of fibrous tissue noted above. So that the assertion is still true, that we have failed to discover any signs of tuberculosis that were easily recognizable in any of the cows here recorded, and these include all we have had under close observation. Those from which milk was

used for inoculations that are not here given had no signs that permitted of even a probable diagnosis by skilled veterinarians.

The following series of experiments are interesting.

III. *Inoculation Experiments with Rabbits.*[1]

1. January 15, 1889. 5 c. c. milk of cow D inoculated. Examined 44 days later. No results.
2. January 15, 1889. 10 c. c. milk of cow D inoculated. Examined 44 days later. No results.
3. January 15, 1889. 6 c. c. milk of cow D inoculated. Examined 44 days later. No results. Small amount of fluid in abdominal cavity.
4. January 19, 1889. 6 c. c. milk of cow E inoculated. Examined 40 days later. No results.
5. January 19, 1889. 8 c. c. milk of cow E inoculated. Examined 40 days later. No results.
6. January 19, 1889. 7 c. c. milk of cow E inoculated. Examined 51 days later. No results. Minute punctate hemorrhages in the lung.
7. January 22, 1889. 3 c. c. milk of cow F inoculated. Examined 38 days later. No results.
8. January 22, 1889. 3 c. c. milk of cow F inoculated. Examined 48 days later. No results.
9. January 22, 1889. 5 c. c. milk of cow F inoculated. Examined 48 days later. No results.
10. January 26, 1889. 5 c. c. milk of cow G inoculated. Examined 45 days later. No results.
11. January 26, 1889. 5 c. c. milk of cow G inoculated. Examined 45 days later. No results.
12. January 26, 1889. 10 c. c. milk of cow G inoculated. Examined 45 days later. No results.
13. January 29, 1889. 4 c. c. milk of cow H inoculated. Examined 51 days later. No results.
14. January 29, 1889. 4 c. c. milk of cow H inoculated. Examined 51 days later. No results.
15. January 29, 1889. 10 c. c. milk of cow H inoculated. Examined 51 days later. No results.
16. February 2, 1889. 4 c. c. milk of cow I inoculated. Examined 54 days later. No results.
17. February 2, 1889. 5 c. c. milk of cow I inoculated. Examined 54 days later. No results.
18. February 2, 1889. 5 c. c. milk of cow I inoculated. Examined 54 days later. No results.
19. February 5, 1889. 2 c. c. milk of cow M inoculated. Examined 57 days later. No results.
20. February 5, 1889. 3 c. c. milk of cow M inoculated. Examined 57 days later. No results.
21. February 5, 1889. 3.5 c. c. milk of cow M " Examined 57 days later. No results.
22. March 5, 1889. 5 c. c. milk of cow L inoculated. Examined 58 days later. No results.
23. March 5, 1889. 6 c. c. milk of cow L inoculated. Examined 58 days later. No results. Wen under throat.
24. March 5, 1889. 4 c. c. milk of cow P inoculated. Examined 58 days later. No results.
25. March 9, 1889. 5 c. c. milk of cow L inoculated. Examined 58 days later. Enlarged gland near liver; pin-head nodules in spleen, liver, kidney, and diaphragm; *all show bacilli under the microscope.*
26. March 9, 1889. 5 c. c. milk of cow P inoculated. Examined 58 days later. No results.
27. March 9, 1889. 5 c. c. milk of cow P inoculated. Examined 58 days later. Pin-head nodules in spleen; hirsute nodules in liver and peritoneum, and large ones in lungs; *bacilli found in all of them.*
28. March 9, 1889. 4 c. c. milk of cow P inoculated. Examined 58 days later. No results.
29. March 9, 1889. 5 c. c. milk of cow O inoculated. Examined 58 days later. No results.
30. March 9, 1889. 4 c. c. milk of cow O inoculated. Examined 58 days later. No results. Nodule size of split pea in edge of liver. Coccidium oviforme.
31. March 18, 1889. 1 c. c. milk of cow E inoculated. Examined 75 days later. No results.
32. March 18, 1889. 1 c. c. milk of cow E inoculated. Examined 74 days later. No results. Unusual emaciation, but nothing else abnormal.
33. March 18, 1889. 1 c. c. milk of cow E inoculated. Examined 72 days later. No results.
34. March 18, 1889. 3 c. c. milk of cow D inoculated. Examined 72 days later. No results.
35. March 18, 1889. 5 c. c. milk of cow D inoculated. Examined 72 days later. No results.
36. March 18, 1889. 4 c. c. milk of cow D inoculated. Examined 72 days later. No results.
37. March 19, 1889. 6.5 c. c. milk of cow F " Examined 73 days later. No results. Coccidium oviforme in liver.
38. March 19, 1889. 6.5 c. c. milk of cow F " Examined 73 days later. No results.
39. March 19, 1889. 1 c. c. milk of cow F inoculated. Examined 73 days later. No results. Bladder worms.
40. March 23, 1889. 3 c. c. milk of cow G inoculated. Examined 74 days later. No results.
41. March 23, 1889. 1 c. c. milk of cow G inoculated. Examined 75 days later. Material lost.

[1] The inoculations were all made in the subcutaneous tissue.

42. March 26, 1889. 1 c. c. milk of cow H inoculated. Examined 71 days later. No results.

43. March 26, 1889. 1 c. c. milk of cow H inoculated. Examined 71 days later. No results.

44. March 26, 1889. 1 c. c. milk of cow H inoculated. Examined 71 days later. No results. Coccidium oviforme in liver.

45. March 30, 1889. 1 c. c. milk of cow L inoculated. Examined 68 days later. No results. Coccidium oviforme in liver.

46. May 11, 1889. 0.5 c. c. milk of cow L inoculated. Examined 52 days later. No results. Small fibromata in liver.

47. May 11, 1889. 0.75 c. c. milk of cow L inoculated. Examined 52 days later. *Bacilli found in small nodules in liver.*

48. May 11, 1889. 1 c. c. milk of cow L inoculated. Examined 52 days later. No results.

49. June 10, 1889. 1 c. c. milk of Slocum's cow inoculated. Examined 51 days later. No results. Uræmia; coccidium oviforme in liver.

50. June 11, 1889. 1 c. c. milk of Slocum's cow inoculated. Examined 51 days later. No results. Uræmia; coccidium oviforme in liver.

51. June 11, 1889. 1 c. c. milk of Slocum's cow inoculated. Examined 52 days later. No results.

52. June 14, 1889. 1 c. c. milk of Saunder's cow inoculated. Examined 47 days later. No results. Apoplexy.

53. June 14, 1889. 1 c. c. milk of Saunder's cow inoculated. Examined 47 days later. *Bacilli found in small nodule in liver.*

54. June 14, 1889. 1 c. c. milk of Saunder's cow inoculated. Examined 48 days later. Cheesy nodule size of hazel-nut at point of inoculation; abdominal glands enlarged; *bacilli in nodule at point of inoculation.*

55. June 16, 1889. 1 c. c. milk of Mayhew's cow inoculated. Examined 48 days later. No results. Coccidium oviforme in liver.

56. June 16, 1889. 1 c. c. milk of Mayhew's cow inoculated. Examined 44 days later. No results. Coccidium oviforme in liver.

57. June 21, 1889. 1 c. c. milk of Mayhew's cow inoculated. Examined 48 days later. No results.

IV. *Results of Inoculations in Guinea-pigs.*

1. January 15, 1889. 8 c. c. milk of cow D inoculated. Examined 44 days later. No results.
2. January 15, 1889. 7 c. c. milk of cow D inoculated. Examined 44 days later. No results.
3. January 15, 1889. 4 c. c. milk of cow D inoculated. Examined 44 days later. No results.
4. January 19, 1889. 4 c. c. milk of cow E inoculated. Examined 40 days later. No results.
5. January 19, 1889. 4 c. c. milk of cow E inoculated. Examined 40 days later. No results.
6. January 19, 1889. 4 c. c. milk of cow E inoculated. Examined 40 days later. No results.
7. January 22, 1889. 3 c. c. milk of cow F inoculated. Examined 48 days later. No results. Punctate hemorrhages in lung.
8. January 22, 1889. 3 c. c. milk of cow F inoculated. Examined 48 days later. No results. Punctate hemorrhages in lung.
9. January 22, 1889. 1 c. c. milk of cow F inoculated. Examined 48 days later. No results. Punctate hemorrhages in lung.
10. January 26, 1889. 3 c. c. milk of cow G inoculated. Examined 4 days later. No results. Acute peritonitis.
11. January 26, 1889. 5 c. c. milk of cow G inoculated. Examined 2 days later. No results. Pleurisy and lobar pneumonia; a pig in same pen at farm had died of pneumonia, Jan. 24.
12. January 26, 1889. 5 c. c. milk of cow G inoculated. Examined 45 days later. No results. Pregnant.
13. January 29, 1889. 4 c. c. milk of cow H inoculated. Examined 51 days later. No results.
14. January 29, 1889. 10 c. c. milk of cow H inoculated. Examined 51 days later. No results.
15. January 29, 1889. 10 c. c. milk of cow H inoculated. Examined 41 days later. No results.
16. February 2, 1889. 3 c. c. milk of cow I inoculated. Examined 54 days later. No results
17. February 2, 2889. 5 c. c. milk of cow I inoculated. Examined 54 days later. No results.
18. February 2, 1889. 4 c. c. milk of cow I inoculated. Examined 57 days later. No results.
19. February 5, 1889. 2 c. c. milk of cow M inoculated. Examined 57 days later. No results.
20. February 5, 1889. 2 c. c. milk of cow M inoculated. Examined 57 days later. No results.
21. February 5, 1889. 2 c. c. milk of cow M inoculated. Examined 57 days later. No results.
22. March 5. 1889. 3 c. c. milk of cow L inoculated. Examined 58 days later. No results.
23. March 5, 1889. 4 c. c. milk of cow L inoculated. Examined 58 days later. No results.
24. March 9, 1889. 4 c. c. milk of cow P inoculated. Examined 9 days later. Cheesy mass at point of inoculation in abdominal walls 1 inch long, 3 lines thick, ½ inch broad; spleen congested; the right lung, middle lobe congested; *bacilli found in cover-glass preparations and in sections.*

25. March 9, 1889. 5 c. c. milk of cow P inoculated. Examined 58 days later. Miliary nodules in liver and spleen, containing *bacilli in sections.*
26. March 9, 1889. 5 c. c. milk of cow P inoculated. Examined 58 days later. Many miliary nodules in liver and spleen containing *bacilli in cover-glasses and sections.*
27. March 9, 1889. 4 c. c. milk of cow O inoculated. Examined 13 days later. Both suprarenal capsules and posterior mediastinal glands enlarged and cheesy; a few nodules in each lung partially softened; *bacilli found in all of them in cover-glass preparations and sections.*
28. March 9, 1889. 2 c. c. milk of cow O inoculated. Examined 58 days later. Miliary nodules in both liver and spleen; *bacilli in sections and cover-glass preparations.*
29. March 9, 1889. 2 c. c. milk of cow O inoculated. Examined 58 days later. No results.
30. March 18, 1889. 1 c. c. milk of cow E inoculated. Examined 64 days later. No results.
31. March 18, 1889. 1 c. c. milk of cow E inoculated. Examined 64 days later. No results.
32. March 18, 1889. 1 c. c. milk of cow E inoculated. Examined 64 days later. No results.
33. March 28, 1889. 2 c. c. milk of cow D inoculated. Examined 64 days later. No results.
34. March 18, 1889. 2 c. c. milk of cow D inoculated. Examined 64 days later. No results.
35. March 18, 1889. 1 c. c. milk of cow D inoculated. Examined 64 days later. No results.
36. March 19, 1889. 0.6 c. c. milk of cow F inoculated. Examined 73 days later. No results.
37. March 19, 1889. 1 c. c. milk of cow F inoculated. Examined 73 days later. Liver contained several small nodules; perihepatitis with adhesions to diaphragm; spleen enlarged; *bacilli found in cover-glass and sections of spleen and liver.*
38. March 19, 1889. 1 c. c. milk of cow F inoculated. Examined 73 days later. No results.
39. March 23, 1889. 1 c. c. milk of cow G inoculated. Examined 73 days later. No results.
40. March 23, 1889. 1 c. c. milk of cow G inoculated. Examined 73 days later. No results.
41. March 23, 1889. 1 c. c. milk of cow G inoculated. Examined 73 days later. No results.
42. March 26, 1889. 1 c. c. milk of cow H inoculated. Examined 41 days later. No results.
43. March 26, 1889. 1 c. c. milk of cow H inoculated. Examined 41 days later. No results.
44. March 26, 1889. 1 c. c. milk of cow H inoculated. Examined 28 days later. No results. Marasmus.
45. March 30, 1889. 1 c. c. milk of cow I inoculated. Examined 41 days later. No results.
46. March 30, 1889. 1 c. c. milk of cow I inoculated. Examined 41 days later. No results.
47. March 30, 1889. 1 c. c. milk of cow I inoculated. Examined 9 days later. No results. Marasmus.
48. April 2, 1889. 1 c. c. milk of cow O inoculated. Examined 65 days later. No results.
49. April 4, 1889. 1 c. c. milk of cow O inoculated. Examined 65 days later. No results.
50. April 2, 1889. 1 c. c. milk of cow O inoculated. Examined 65 days later. No results.
51. April 2, 1889. 0.5 c. c. milk of cow O inoculated. Examined 65 days later. No results.
52. April 2, 1889. 1 c. c. milk of cow O inoculated. Examined 65 days later. No results.
53. April 2, 1889. 1 c. c. milk of cow O inoculated. Examined 65 days later. *Bacilli found in liver in small nodules.*
54. May 11, 1889. 0.5 c. c. milk of cow L inoculated. Examined 52 days later. No results.
55. May 11, 1889. 1 c. c. milk of cow L inoculated. Examined 52 days later. No results.
56. May 11, 1889. 1 c. c. milk of cow L inoculated. Examined 52 days later. No results.
57. June 10, 1889. 1 c. c. milk of Slocum's cow inoculated. Examined 52 days later. No results. Many small nodules in spleen, a few in liver. Microscopic examination hasty.
58. June 10, 1889. 1 c. c. milk of Slocum's cow inoculated. Examined 52 days later. No results.
59. June 10, 1889. 1 c. c. milk of Slocum's cow inoculated. Examined 52 days later. Enlarged lymphatic gland in inguinal region; many minute nodules in spleen; a few in liver; *bacilli in sections of gland.*
60. June 14, 1889. 1 c. c. milk of Saunder's cow inoculated. Examined 50 days later. Spleen slightly enlarged and granular; *bacilli in sections of spleen.*
61. June 14, 1889. 1 c. c. milk of Saunder's cow inoculated. Examined 50 days later. Spleen slightly enlarged and granular. Microscope—not finished in September.
62. June 14, 1889. 1 c. c. milk of Saunder's cow inoculated. Examined 50 days later. Spleen slightly enlarged and granular. Microscope: negative; examination hasty.
63. June 21, 1889. 1 c. c. milk of Mayhew's cow inoculated. Examined 50 days later. Spleen enlarged and granular; liver contained two small white spots; enlarged gland in inguinal region; *bacilli found in section of gland.*
64. June 21, 1889. 1 c. c. milk of Mayhew's cow inoculated. Examined 59 days later. Spleen enlarged and granular; enlarged lymphatic glands in inguinal region. Microscope: *bacilli in gland*
65. June 21, 1889. 1 c. c. milk of Mayhew's cow inoculated. Examined 50 days later. Spleen enlarged and granular; liver one large nodule; enlarged lymphatic glands in inguinal region. Microscope: *bacilli in gland.*

We also made an interesting series of experimental inoculations in rabbits and guinea-pigs with milk or cream from various cows, in varying quantities and at different times. Of rabbits there were used fifty-seven animals. Of these, five were inoculated with milk which had turned sour, two died of intercurrent diseases in a few days (coccidium oviforme), and of one the material was lost before the microscopic examination was completed—so that eight animals are to be rejected, leaving forty-nine upon which the results can be based. Out of these, five were made more or less tuberculous, as proven by microscopic examination, and in forty-four the results were negative—that is to say, we obtained 5 : 49, or 10.2 per cent. of success out of all inoculations in rabbits.

There were used thirty-three different specimens from thirteen different cows—that is, there were 23 per cent. (3:13) successful results from the cows used, and 15.15 per cent. (5:33) successful results from the specimens used.

Positive results were obtained from

Cow P twice (at different times).

Cow L once.

Saunder's cow twice (at different times).

The results of the inoculations of guinea-pigs are more striking. There were sixty-five animals used in all. Of these, nine were inoculated with sour milk or cream, and two died in a day or two of other diseases (peritonitis and pleurisy). There are, therefore, but fifty-four that should be counted. In them, there were twelve positive results, or 28.57 per cent. (12:42) successes out of all the inoculations. There were used thirty-two specimens from fourteen different cows, and the successful results came from six different cows—that is, 42.8 per cent. (6:14) of the cows were shown in this way to have infectious milk, and 37.5 per cent. (12:32) of the specimens used were shown to have active infectious properties.

Positive results were obtained from

Cow P (three times in two different inoculations).

Cow D (three times in three different inoculations).

Cow F (once).

Slocum cow (once).

Saunder's cow (once).

Mayhew cow (three times in two different inoculations).

The combining of the results obtained from both rabbits and guinea-pigs shows the following: Successful results were obtained in milk from cow P three times (two different specimens) in guinea-pigs, and twice in rabbits (two different specimens); from cow L once in rabbits; from cow O three times (three different specimens) in guinea-pigs; from cow F once in guinea-pigs; from the Slocum cow once in guinea-pigs; from the Saunder's cow once in guinea-pigs, and twice in rabbits (two different specimens), and from the Mayhew cow three times in guinea-pigs (two different specimens)—that is to say, out of fourteen cows used the milk was shown to be infectious in seven, or 50 per cent., by inoculation experiments.

An interesting fact is also shown by a comparison of Tables I., III., and IV., and that is, that bacilli were found in the milk or cream, and successful inoculation experiments made in animals with the same specimen in five different cases (including eight of the successful ones) as follows;

Comparison of the dates when Bacilli were found in the Milk and the same Milk was used for successful Inoculation Experiments.

Cow.	*Positive.* Cover-glass.	*Positive.* Guinea-pig.	*Positive.* Rabbit.
P.	Cream, A.M.	Cream, A.M., March 9, 1889	Cream, A.M., March 9, 1889
	Cream, P.M.	Cream, P.M., March 9, 1889 Cream, P.M., March 9, 1889	Cream, P.M., March 9, 1889
O.	First of milking, cream, March 9, 1889.	First of milking, cream, March 9, 1889	
Slocum.	Last of milking.	Last of milking, June 10, 1889	
Mayhew.	Last of milking, milk.	Last of milking, milk, June 21, 1889	

The inoculation experiments, above detailed, seem to me to be deserving of consideration because they were done under the most careful precautions that could be devised. In all cases the experiment animals were kept under observation long enough to determine, so far as could be seen, that they were in good health, and after the inoculations they were separated and kept under close watch, but in healthy surroundings. Some of those that were used were inoculated immediately after purchase, because of a scarcity of the supply at the farm, and were not in good condition. But as no sign of tuberculosis appeared in any of these, their ill health cannot come in as a disturbing factor in the results.

Table V. shows the results obtained from certain feeding experiments with calves.

V. *Results of Feeding Experiments with Calves.*

1. Calf A. February 18, 1888. Healthy parentage. To Feb. 27th fed with milk from cow H, to Dec. 19th from cows A and B, and to Sept. 26th from cows A and C. Sept. 26th, temp. 102.5°; feverish and constipated on April 16th, temp. 104°, otherwise fairly well. Killed Sept. 26, 1888. Two mediastinal glands much enlarged and calcareous, and a nodule as big as a pigeon's egg in the middle lobe of the right lung; one of the post-pharyngeal glands was enlarged, as well as a prescapular gland on the left side. Microscope: *bacilli in all these specimens.*

2. Calf B. February 29, 1888. Healthy parentage. To April 9th fed with milk from cows B and C, to July 6th from cows B and H. Began to breathe badly in about a month; became gradually worse, with increasing cough; temp. from 101.5° to 103°. Killed July 6, 1888. Posterior laryngeal lymphatics enlarged, especially on right side, with cheesy and calcareous deposits, accounting for the difficulty in breathing; an enlarged gland in mediastinum; two small nodules in anterior lobe of right lung; a nodule on posterior face of the liver. Microscope (A. P.): negative as far as bacilli are concerned.

3. Calf C. April 3, 1888. Healthy parentage. Fed with milk from cow E. Sept. 25th, temp. 102.5°. Killed Sept. 26, 1888. Slightly enlarged mediastinal and lymphatic glands; some fat around heart; general appearance good; material not saved.

4. Calf D. April 9, 1888. Healthy parentage. Fed with milk from cow D. Sept 25th, temp. 102°. Killed Sept. 26, 1888. Very few small nodules in the liver. Microscope showed *bacilli of tuberculosis.*

5. Calf E. July 9, 1888. Healthy parentage. Fed with milk from cow J. Killed Jan. 9, 1889. Nothing abnormal found.

6. Calf F. September 21, 1888. Health parentage. Fed with milk from cow J. Killed April 10, 1889. A few small diffuse nodules in liver, and a slightly mottled appearance of one kidney. Microscope showed *bacilli of tuberculosis.*

7. Calf G. October 14, 1889. Born on farm. Fed with milk from cows D and J. Killed April 10, 1889. A few small nodules in liver. Microscopic preparation thrown away.

8. Calf H. December 4, 1888. Healthy parentage. Fed with milk from cows E and F. Killed April 10, 1889. A small pale spot in liver near lower border of right lobe. Microscope showed *bacilli of tuberculosis.*

9. Calf I. February 18, 1889. Healthy parentage. Fed with milk from cow D. July 20th, temp. 101.5°. Killed Aug. 13, 1889. Two small whitish spots on anterior surface of the liver. Small congested patches on surface of kidney running into the medullary portion. A hasty microscopic examination of kidney negative.

10. Calf J. February 25, 1889. Healthy parentage. Fed with milk from cows O and K. April 29th, calf coughs a little; June 20th, temp. 102°; July 10th, temp. 102°; cough had disappeared. Slight increase in size of mesenteric lymphatic glands; kidneys similar to those of calf J. A hasty microscopic examination of gland negative.

11. Calf K. March 29, 1889. Healthy parentage. To April 13th fed with milk from cow M. April 29th slight running at nose; June 18th coughs a little; June 20th much cough; temp. 102.6°; July 20th temp. 102.2°. Kidneys congested as preceding; a small whitish spot on the liver; posterior portion of right lung solidified slightly (looking a little like lung of contagious pleuro-pneumonia); pleura thickened; microscopic appearances similar to those of chronic interstitial pneumonia; a hasty microscopic examination of kidney negative.

12. Calf L. May 1, 1889. Healthy parentage. Fed with milk from cow L. June 3d coughs slightly; June 4th much cough; June 20th temp. 102°; July 20th temp. 102.5°, cough less, and Aug. 1st none. Nothing found except slight congestion of kidneys in patches, similar to preceding. Microscopic examination showed simple hyperæmia.

13. Calf M. May 3, 1889. Healthy parentage. Fed with milk from cow R. June 18th slight cough; June 20th temp. 101.5°; July 20th temp. 101.6°; Aug. 1st no cough. Kidneys congested as preceding; liver contained a number of grayish, translucent nodules, some size of a pea, similar to miliary tuberculosis. Microscopic examination showed *bacilli of tuberculosis in liver.*

14. Calf N. May 16, 1889. Healthy parentage. Fed with milk from cow P. July 2d temp. 102°. Not killed in September.

15. Calf O. May 17, 1889. Healthy parentage. To June 1st fed with milk from cow F, cow E. July 20th temp. 102.6°. Not killed in September.

By this table it appears that there were thirteen calves used, and fed for varying lengths of time with milk from cows affected with tuberculosis, but not of the udder. Of these, the material was thrown away from one before the microscopic examination, and this should be rejected in the final results. Of the remainder there were five posi-

tive results obtained and one suspicious. The latter is counted as negative, for the reason that, although giant cells and granulation tissue were seen, no bacilli were found. There were, therefore, five out of twelve positive results, or 41.66 per cent. It should also be said that of those counted as negative three sets of specimens were suspicious, but were hastily examined for the purposes of this paper, so that a more careful search may very probably increase the percentage of success.

The last table I shall present (VI.) is made up from feeding experiments on one set of pigs, the milk being given to them from the same cows as before; there were seven pigs used in all, from one litter and healthy parents.

Of these, examination showed negative results in two, positive results in two, one was subjected to a very hasty microscopic examination, and the material from two was thrown away—a mistake, as was shown by the results of the microscopic examination of the material from No. 3. There are to be counted, therefore, only five, giving as successful results 40 per cent.

VI. *Results of Feeding Experiments with Pigs.*

1. March 28, 1883. Bought in Brighton; eight months old. May 28th changed to open-air pen; cough before this, which lessened, and disappeared in a month. Fed with milk from cows E and H; both tuberculous, but with no lesions in the udder. Killed July 26, 1888. Slight pleuritic adhesions of left lung; liver in both anterior and posterior surfaces showed yellowish nodule size of a pin-head. Microscopic examination showed *bacilli of tuberculosis in the liver.*

2. March 28, 1888. History same as in No. 1. Fed with milk from same cows as in No. 1. Killed July 26, 1888. Small nodule in left lung on external surface. Nodules in liver similar to those in No. 1; submaxillary lymphatics somewhat enlarged. Microscopic examination not completed.

3. March 26, 1888. History same as in No. 1. Fed with milk from same cows as in No. 1. Killed September 26, 1888. Post-mortem negative.

4. March 28, 1888. History same as in No. 1. Fed with milk from same cows as in No. 1. Killed September 26, 1888. Post-mortem negative.

5. March 28, 1888. History same as in No. 1. Fed with milk from same cows as in No. 1. Killed December 11, 1888. Post-mortem negative.

6. March 28, 1888. History same as in No. 1. Fed with milk from same cows as in No. 1. Killed December 11, 1888. Post-mortem negative.

7. March 28, 1888. History same as in No. 1. Fed with milk from same cows as in No. 1. Killed December 11, 1888. Two small nodules in the spleen and a few in the liver. Microscopic examination showed *bacilli of tuberculosis.*

By the cover-glass examinations we have shown that the milk contained infectious material in ten cows out of thirty-five from which the milk was examined for bacilli—that is, in 28.57 per cent. We have also shown that the milk was infectious, by inoculation experiments, in seven out of fourteen of the cows from which the milk came—that is, 50 per cent. And we have shown the infectious nature of the

milk by ocular demonstration and successful inoculation from the same specimens in five out of fourteen used—or, 35.7 per cent.

These results are, to a certain extent, preliminary—that is to say, they are but part of the work upon this subject which is being done under the auspices of the Massachusetts Society for the Promotion of Agriculture. The work will not be completed, at any rate, until next year.

They show, however:

1st, and emphatically, that the milk from cows affected with tuberculosis in any part of the body may contain the virus of the disease.

2d. That the virus is present whether there is disease of the udder or not.

3d. That there is no ground for the assertion that there must be a lesion of the udder before the milk can contain the infection of tuberculosis.

4. That, on the contrary, the bacilli of tuberculosis are present and active in a very large proportion of cases in the milk of cows affected with tuberculosis but with no discoverable lesion of the udder.

DISCUSSION.

DR. W. T. COUNCILMAN: I regard this paper as one of the most valuable contributions that have been lately made to the history of tuberculosis. There is no impossibility in the way of the bacillus being present in the milk without any lesion of the udder. This is perfectly analogous to the presence of the bacilli in the tubules of the testicle without any tubercular lesion of the testicle. Some of the most important results that have come from the recent studies of tuberculosis have been the light thrown on the mode of inoculation. It is known that in human tuberculosis inoculation by the alimentary canal plays an important part. It is probable that in almost all cases of mesenteric tabes the infection takes place by the alimentary canal. It has been very conclusively shown that this may occur without any demonstrable lesion of the alimentary canal. This occurs not only in children, but in certain cases of adults it can be conclusively shown that the virus must have entered in this way, because we find the first changes in the lymph glands supplied by the lymph vessels from the alimentary canal, and if there is further infection it proceeds from these glands. I have a case in mind where the primary lesion was a large ulcer of the small intestine, and from this ulcer general peritonitis was set up. That was in a man, sixty years of age.

I think that one thing should be taken into consideration in regard to the frequency with which children become infected through the alimentary canal, and that is, that possibly the infection is not in all cases to be attributed to the food. Children have a habit of putting all things in their mouths, and the children of tuberculous parents have ways of getting the bacilli into their alimentary canals in other methods than by the food.

I think that it would be an important thing for the government to take in hand the stamping out of tuberculosis in the same way as it has pleuro-pneumonia, by killing all of the affected animals. This would, of course, involve an enormous outlay of money, but one which would bear ample recompense. It is, however, doubtful if this could be made as thorough a procedure as in the case of pleuro-pneumonia. In the latter affection, when we have destroyed all the disease we have done away with all the means of infection in that immediate neighborhood, whereas, in tuberculosis, if we should destroy all of the tuberculous cattle in a certain area, we have the possibility of infection of cattle by men. I do not think that much is known in regard to the modes of infection in cattle. We do not know how far infection takes place from cow to cow. Cows are known not to expectorate much. If it is true that cattle become infected from men, it would be difficult to stamp out the disease effectually, although it would be lessened by killing the infected cattle.

DR. WILLIAM H. WELCH: I desire to express my admiration for the valuable work done by Dr. Ernst. The results reported in his paper constitute an original and genuine contribution to our knowledge of an important subject. As he has said, Koch's statement that the milk of tuberculous cows is likely to carry infection only when the udder is tuberculous, was based evidently upon theoretical reasoning. There is no experimental basis for that statement. It is only comparatively recently that this aspect of the question has become prominent. The first investigations were directed to the determination of the nature of bovine tuberculosis or *perlsucht*, particularly as to its identity with human tuberculosis. When this identity was established, the next point was to determine the transmissibility of bovine tuberculosis by inoculation of animals, and when the milk was used in these experiments, naturally, cases were selected in which the udder was manifestly tuberculous. The positive results obtained in these inoculations, of course, did not justify the inference that the milk might not also be infectious in tuberculous animals without evident disease of the mammary glands. These results made it important to undertake just such experiments as those conducted by Dr. Ernst. All of the experiments hitherto made upon this point, particularly those of Bollinger, tend in the same direction, namely, to the conclusion that the milk is capable of conveying tuberculous infection in a certain, and that not a small, number of tuberculous cows, whose udders are apparently free from tuberculous disease, but in none of the experiments has the demonstration been so complete and satisfactory, and based upon so large a material as in those of Dr. Ernst.

The question is of pathological, rather than of practical interest, whether in these cases the udder, although gross tuberculous lesions are absent, is actually free from tuberculous foci. This question can be answered only by a careful histological study of the mammary gland, and this is likely to prove most laborious. The observations of Jani have shown that tubercle bacilli may be present in the genital glands without tuberculous lesions, and the same may be true of the lacteal glands.

When the tuberculous process is localized in the thoracic cavity, as is customary, there seems to be only one way by which the tubercle bacilli can be conveyed to the mammary gland, and that is by the blood-current. A careful study of the tuberculous process in human beings, shows that it cannot be rare in ordinary cases of localized pulmonary tuberculosis for a few tubercle bacilli to enter the general circulation, too few to cause generalized miliary tuberculosis. We find not infrequently in these cases a few scattered miliary tubercles in the kidney, the spleen, and other organs. We cannot suppose that the infectious quality of the milk is referable simply to the bacilli which may be conveyed to the gland by the circulation, for the meat of these animals is not found to contain enough bacilli to carry infection, and it is not apparent why the bacilli should not reach the muscular tissue as well as the mammary gland. Bollinger assumes that the tubercle bacilli are eliminated by the mammary gland. It seems likely that the tubercle bacilli brought to the gland by the blood current escape into the milk, and here, in this favorable culture medium, in the acini and ducts, may multiply. We cannot, however, with our present knowledge, assert that this takes place without any histological change, although it is clear that it may occur without easily demonstrable change. The supposition that the milk becomes infected by tubercle bacilli entering the lacteal ducts from without, seems to me less probable than the view suggested.

It would be interesting if Dr. Ernst would tell us what lesions were produced in the calves and pigs which he successfully infected with the milk. Were lesions produced like those observed in sucking pigs whose mothers have tuberculous udders? In these I have seen the mucous membrane of most of the intestinal canal converted into an almost continuous caseous mass, rich in tubercle bacilli, a picture unlike anything observed in the intestinal tuberculosis of human beings.

DR. H. C. ERNST: The appearances referred to by Dr. Welch would not be likely to be found in the animals we experimented upon, for the reason that they were killed too soon. We killed, as a rule, six weeks after the inoculation, in order to avoid as far as possible the chance of accidental infection. We never got very advanced tuberculosis in any case, but it seemed better to avoid this chance of accidental infection by early killing, and as far as possible, than to wait for further pathological change.

HOT AIR INHALATIONS IN PULMONARY TUBERCULOSIS.

By E. L. TRUDEAU, M.D.,
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The exact value of any therapeutic measure in the treatment of phthisis can only be determined after a considerable lapse of time and a comparison of the clinical reports of different observers made on an extensive scale. The present notes, therefore, which only embrace the study of four cases treated for periods varying from one to a little over four months, can necessarily constitute but a very meagre contribution to the clinical side of the question. Inasmuch, however, as the inhalation of hot air has been put forward as a distinctly antiparasitical method, the report of some observed facts bearing on the bacterial study of these cases may, even at this early date, prove of some value in reaching a conclusion regarding its merits as a specific.

The literature of the subject has until recently been confined to the observations of Louis Halter,[1] published in September, 1888, on the immunity of lime-burners from pulmonary phthisis; to the work of Dr. Krull[2] on hot air inhalations for tuberculosis, and to a paper published by Dr. Louis Weigert in the *Medical Record* for December, 1888. More recently articles by A. Jacobi,[3] Renzi,[4] Kohschutter,[5] and Sears,[6] reporting the results of their observations in treating phthisis by this method, have appeared. Dr. Weigert's claims were, to have discovered in hot air inhalations a specific treatment for tuberculosis, and that this disease could be cured by the use of an apparatus devised by himself for the purpose.

[1] Berliner klinische Wochenschrift, September, 1888. [2] Ibid., September, 1888.
[3] New York Academy of Medicine, June 20, 1889.
[4] Morgagni, No. 17, 1889, and Centr. f. die gesammt. Ther., June, 1889.
[5] Inter. klin. Rundschau, No. 10, 1859.
[6] Boston Medical and Surgical Reporter, July 11, 1889.

In his article, hot air inhalations are distinctly put forward as a specific for pulmonary tuberculosis. They are not held to be merely a therapeutic measure of more or less service, and no influence other than their efficacy in checking the growth and multiplication of the tubercle bacillus is claimed for them. Based on well-observed facts relating to the narrow temperature range of this microbe, the diminution of virulence which may be brought about in certain pathogenic bacteria by growing them at high temperatures, and the efficacy of discontinuous sterilization, this plan of treatment is worthy of serious consideration.

Are inhalations of dry hot air capable of preventing the growth of the bacillus tuberculosis in the lungs of living individuals, or of diminishing the virulence of this microbe? The present notes are but a collection of clinical facts and bacteriological observations made by the writer in attempting a solution of this question. The clinical study includes four cases: the first three will be briefly outlined, while the fourth, for reasons that will appear hereafter, will be given more in detail.

These three patients had all been ill less than a year, and presented the rational and physical signs of moderately advanced pulmonary tuberculosis in its first stages; in one only was a small excavation present. The sputum which contained bacilli in all the cases, was examined every month, and careful records of the vital signs were kept. These patients took the treatment continuously for periods of one month, six weeks, and a little over three months respectively; the time of inhalation was rapidly run up to four hours daily, divided into two sittings, during which the temperature of the inhaled air (as measured by the thermometer on the mouthpiece), was maintained over 200° C. (392° F.).

The results were as follows: In the first and second cases slight improvement in all the symptoms occurred at once, but the patients became discouraged and could not be persuaded to continue the inhalations. The third patient kept up the treatment most rigorously for over three months without the least noticeable effect.

The history of the fourth patient before and after treatment was as follows:

January 28, 1889. R., clerk, aged twenty-three; no family history of phthisis. Taken ill, July, 1888, with hæmoptysis; has all the rational signs

of progressive pulmonary tuberculosis in its first stages; has lost ten pounds. Both lungs are involved. At right apex prolonged bronchial expiration, with fine and coarse râles both back and front, involving the upper lobe. At left apex breathing good, except under the clavicle, where some fine crackles and loss of breath-sounds prevail. Temperature P.M. daily, 101½° to 102°; respiration 24; pulse 100 to 120. Expectoration moderate in quantity and purulent.

Began treatment February 18, 1889, and inhaled air (200° C. to 210° C.) four hours daily, with but trifling intermissions, until June 20, 1889. A complete record of the vital signs was kept, and the sputum was examined every five weeks for bacilli. His condition at the end of treatment (a little over four months) was as follows: Physical signs show marked decrease in the amount of râles, which have entirely disappeared over the right scapular region. *Rational signs:* Weight has increased 10 pounds; pulse shows an average decrease of 8 beats; respiration has fallen from 24 to 19 on an average; temperature usually about 2° Fahr. lower; sweats have disappeared; dyspnœa improved; no hæmoptysis; expectoration has diminished two-thirds in quantity and is still muco-purulent in the morning. The improvement reached its height about three months from the inception of treatment; some of the ground gained was slowly lost during the fourth month, though the inhalations were faithfully continued.

This brief clinical study does not furnish evidence which differs materially from that usually obtained on the trial of many specific methods of treatment for tuberculosis hitherto put forward and long ago abandoned. The improvement which manifested itself in one case, though marked, was no greater than was observed to occur at the same time, from climatic and hygienic treatment alone, in several of the man's fellow patients. Whether or not the favorable change noted in his condition can be ascribed to any specific effect produced on the germ element of his disease by breathing the hot air will hereafter be shown conclusively by the inoculation tests to which his sputum was subjected.

These brief clinical notes may be said to furnish no positive proof as to the therapeutic value of the method.

The bacteriological study was as follows: The sputum in all four cases was examined before treatment, at intervals of five weeks during treatment, and as soon as it was abandoned. *In every instance the bacilli were found.* No appreciable influence therefore was produced upon this most important element of the disease.

The claim of diminished virulence was tested in the following manner: Before beginning the inhalations a small portion of the

sputum from Case IV. was mixed with sterilized water and injected into the thoracic cavity of three rabbits. The animals were killed five weeks later and a localized tubercular lesion at the site of injection was noted, while transparent miliary tubercles were just visible on the pleura and pericardium. These lesions contained bacilli. The patient having begun to breathe hot air for four hours daily, a small portion of his expectoration was taken every five weeks and injected in the same manner into the thoracic cavity of three rabbits. This was repeated three times—that is, the last set of inoculations was made three months and a half after the treatment had been begun. Each set of rabbits was killed at intervals of five weeks and notes of the autopsies made. They were found to have all developed tubercular lesions containing bacilli, and in the last lot as well as in the others miliary tubercles occurring at some distance from the site of injection were demonstrated. These tubercles were sufficiently advanced to be macroscopical, and did not differ materially in their appearance from those which had been produced in the animals inoculated with material expectorated by this man before the treatment was instituted. Five weeks being very nearly the earliest date at which secondary tubercle distant from the original lesion appears, microbes capable of causing such manifestations within this limited time can have lost none of their virulence. No diminution in the pathogenic properties of the bacilli seems therefore to have been produced by breathing the heated air.

Although difficult of absolute demonstration, it is most probable that the temperature of the air-cell itself can be influenced but very slightly, no matter how high or how low that of the inspired air may prove to be. The intense vascularity of the lungs, the fixed temperature of the blood rapidly circulating through them (which is relatively low when compared to that of the heated atmosphere furnished by the apparatus), the moisture and infinite subdivision of the surfaces, and the very slow admixture which takes place between the tidal and residual air, all conspire to rob the incoming current of its heat and to confine the possible variations of temperature in the air-cell within very narrow limits.

The inference held out as conclusive, that because the breath on expiration measures as high as 45° C., the air in the air-cells must necessarily be much warmer, is fallacious, for the expired air is in a great part composed of the last inspiration still surcharged with its

recently acquired heat. As the bacilli in the bronchial secretions must necessarily be brought in much more intimate contact with the hot air than those imbedded in solidified areas of lung or in impermeable tubercular masses, the failure of the latter agent to diminish their virulence to any appreciable degree is most significant.

CONCLUSIONS.

1st. The therapeutic value of hot air inhalations in phthisis is doubtful.

2d. The evidence obtained by the bacteriological study of the cases presented does not confirm the assumption that inhalations of heated air can either prevent the growth of the tubercle bacillus in the lungs of living individuals or diminish the virulence of this microbe when it has gained access to them.

PRIMARY MALIGNANT DISEASE OF THE DUODENUM.

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Many regard the question of primary malignant disease of the upper bowel, unpromising and unprofitable for discussion; that cutting down upon and into the mass of literature on the subject will only serve to confirm the pre-existing opinion of the complex nature of the theme, and to reveal such blending and fusion with adjoining topics as to demonstrate anew the impossibility of an accurate and clean dissection and enucleation of the question.

The leading authorities are in concord with reference to the diagnostic difficulties met with in subjects of intestinal malignant disease. No rules have yet been drawn up, no tables have yet been formulated, no plan has yet been presented, no safe scheme has yet been devised by which speedily or in any important degree to the advantage of the patient, an early diagnosis of cancer of the digestive tube can be established. To the clinician, the evidence furnished by the subjective and objective symptoms may appear convincing in large measure, nevertheless it is defective and incomplete, lacking "definition" in the relation which the rational and physical signs should sustain to each other; nor do the methods employed in differential diagnosis lead with sufficient directness to definite and logical conclusions; the various factors do not coincide in any such degree of harmony as to afford conclusive and cogent reasons upon which to base positive diagnosis.

It is, therefore, by the method known as "exclusion" that the most accomplished diagnosticians achieve their desirable results when called upon to deal with this complex question; and to each and every diagnosis of cancer of the small intestine, there should be appended the reserve clause, "an autopsy is needed for full confirmation."

To some it may appear that this pronounced opinion bearing on the

diagnosis of malignant disease of the upper bowel, can apply to the disorder in its earliest stages only, yet all who have had to deal with subjects of this class must admit that in all its stages the disease begets doubts, uncertainties, and indecisions which torment the attending and consulting physicians, and we are prepared to concede that to the necroscopist—"he who views the body after death"—must be relegated in such cases one of our choicest privileges, the power of clear and definite ante-mortem diagnosis.

I find myself limited by the subject chosen for this paper, to the consideration of those cases wherein the malady is located in that portion of the digestive tube which is actively engaged in digestive processes; for, however much we may know of the function of the large intestine in reference to absorption, and however great the temptation to include in my theme intestinal cancer as a whole, and particularly the localities where its frequency is greatest, and diagnostic features are most pronounced, we must grant that the colon and the rectum do not play any important part in the preparation of food for the maintenance of life.

The statistical element in intestinal cancer is extremely unsatisfactory and incomplete; but few tables are in existence, and none of these is definite. The subject of primary intestinal cancer with reference to precise or comparative seat and percentage of location cannot be developed profitably with the material at our command. The statistics at present accessible are not useful, and they are contradictory. We cannot separate from the mass of the reports, data which will enable us to conclude what proportion of intestinal neoplasms are duodenal, what are of other parts of the small intestine; nor can we advance much beyond the Vienna tables, now classical, wherein

Cancer of the	Rectum was	80	per cent.	of the	whole.
" "	Colon was	11.5	"	"	"
" "	Ileocæcal Valve and immediate parts was . . .	4.1	"	"	"
" "	Small Intestine was . .	4.3	"	"	"

Further computation, from all sources, would give about one per cent. of intestinal cancer primary in the duodenum. This is the nearest approach which has yet been made, except in some of the smaller tables, toward determining the relative frequency of the different seats of primary cancer of the intestine. For instance, Köhler's

table of thirty-four cases is incomplete because he throws out cancer of the rectum and groups

Large Intestine	22 cases
Small Intestine	12 "

(and of the twelve, nine are of the duodenum); but he fails to mention the segment in which the largest number originated. It might further be stated that intestinal cancer as compared with cancer of other parts of the body varies according to the Geneva and the Vienna list from 4 per cent. to 5.4 per cent.

It is quite generally conceded that the most prominent and persistent factor associated with intestinal morbid growths is diminution of the lumen of the tube, and that whether the neoplasm be cylinder-cell, epithelioma, scirrhus, colloid, encephaloid, adenoid, sarcomatous or lymphadenoma, or even benign, the constant tendency is toward obstruction; the most reliable diagnostic symptoms are those arising from impaired permeability.

The mechanism of the process has been defined by the terms obturation, occlusion, and constriction. I think that the frequently employed term occlusion has no place in the diagnostic nomenclature of the disease under consideration, except in so far as it may serve to define or describe the position of a growth which occludes the common duct, and prevents the passage of pancreatic and hepatic secretions into the intestinal canal.

The essential facts are, that a certain class of intestinal new growths arise as disks, as fungoid growths, or as villous prolongations; many other forms at some period assume this type of development, and all such project into the canal and delay or arrest and finally obstruct the passage. Other new growths implicate the circumference of the intestine, spread rapidly around the gut, girdling it, and causing notable annular constrictions. So that from one or the other of these two methods, or from both operating in unison, the result obtains with great precision, and the tendency toward complete closure of the canal is persistent and prominent.

It should not be lost sight of that the character, or rather the degree of density of the intestinal contents varies with location, and that the contents of the stomach are poured out through the pyloric orifice in a liquid or semi-liquid state, rendering it possible for a passage to

be effected through an extremely small opening, and without the aid of any large degree of peristalsis.

It is this feature which serves to mask the degree of obstruction induced by the neoplasm, and places high among the rational signs of cancer of the duodenum, the extremely negative symptom of latency. There cannot be in such a disorder in such locality the influences which are powerful in obstructive disorders lower down in the intestine. I refer to the compensatory hypertrophy of the muscular coat of the bowel; hence it not unfrequently arises that the symptoms of lessened calibre for a long time latent suddenly declare themselves with great force, and with all the symptoms of an acute and complete stenosis.

Diagnostic difficulties multiply as we ascend the intestinal canal. Localization by tabular views and by percentages places by far the largest number of cases of cancer of the gut, in the rectum, where the largest opportunity is found for determining the seat of the disease by the employment of the more advanced methods of exploration and examination; the physical and correlative signs are more positive and less confusing in proportion as we near the outlet. In the duodenum the symptoms worthy of the largest confidence are those arising from occlusion of the common duct, with or without evidence of obturation or constriction of the intestine, and the resulting dilatation of the stomach and first segment of the duodenum; for it is at this point that the larger number of duodenal cancers are found. When the disease affects the upper third it is with the greatest difficulty differentiated from pyloric cancer, but because the bile and pancreatic secretion find their way into the intestine, intestinal digestion is less disturbed, while if the disease is in the lower third, the presence of bile as a frequent element in the matter vomited, and the evidence of gastric dilatation, are important symptoms. Blood may appear either in the dejecta or in the vomitus, according as the gut is pervious or as the ulcerative processes affect the upper portion or the lower part of the obturating mass.

The quantity and the quality of the food descending into the intestine determine in large measure the external appearance of the abdomen, though it should be borne in mind that tympanites from intestinal flatulency may closely resemble the meteorism which is constant in cases where obturation or constriction originates in malignant

disease of the large intestine. The result, however, in cancer of the duodenum is generally that the belly is shrunken and depressed, "boat-shaped," and this is an important reciprocal sign in connection with gastrectasis, and serves to measure, to a considerable extent, the degree of hindrance to the passage of food induced by the neoplasm.

Pain is a very uncertain element in the diagnosis and localization of the disease. Enteralgia arises from so many different causes, and is so frequent in the disorders associated with malignant disease of the abdominal contents, that its significance is extremely doubtful and its aid in diagnosis unfortunately small, and as a symptom very unreliable.

The pain induced by the local disease is frequently masked by the coincident and consequent pains of flatulent colic, the result of disordered intestinal digestion; changes in the proportions of the intestinal fluids engaged in digestion are notably frequent, and find expression in malnutrition and colicky pains, most marked when the disease involves the mid-section of the duodenum and leads to partial and temporary, or complete and permanent occlusion of the common duct. Jaundice, when present, confirms the opinion that the disease is located as above stated.

No portion of this subject is so unsatisfactory as the question of tumor. Tumor, in other forms of intestinal cancer, is present in a large and desirable degree of certainty; there seems to be some warrant for the feeling that exists at the time of examinations, in cases of suspected malignant disease of the rectum, or of the large, as well as of the small intestine, that the absence of tumor disproves the apprehension and assures the physician that his fears were not well grounded. The rectum, the flexures of the large intestine, and the coils of the small intestine, all afford opportunity for determining the absence or the presence of neoplasms of the type under discussion.

But such is not the case in malignant disease of the duodenum; discoverable, demonstrable tumors do not exist in any considerable percentage of frequency. We are told that the presence of a tumor confirms diagnosis, but we are not permitted to believe that the absence of an appreciable tumor will enable us to dismiss our fears that an active malignant process has already been established, whose course is short and whose termination is speedy and fatal.

Due appreciation of the relative infrequency of tactile, tangible

evidence of the disease, does not exist in the profession at large. Text-books are defective in explicitness in this direction. The bare statement that a tumor, when present, confirms the diagnosis, is insufficient and misleading; the sources of error, with reference to the nature of tumors in this locality, are large, and fruitful of mistakes, and hardly need be enumerated; and it must always remain a cause for regret that subjective symptoms, seemingly direct and conclusive, should lack confirmation through the absence of the objective sign whose positive palpable presence the existence of the disease would seem necessarily to imply.

I append a brief synopsis of thirteen cases of primary malignant disease of the duodenum, not previously presented in connection with a paper on this topic.

CASE I.—Male, seventeen years. A glutton, and addicted to strong liquors. For over a year had occasional vomiting and more or less violent colic, the attacks becoming more severe. Bowels habitually loose. Two days before death, after eating to excess, he vomited; vomitus was at first food, then black matter. Gastric colic became extreme, vomiting became stercoraceous. Great prostration. Cardiac failure. Mind clear. Death.

Autopsy: Stomach enormously dilated. In duodenum, just below opening of the bile-duct, was a mass of scirrhous cancer, ulcerated, and at one place perforated. General peritonitis. Elsewhere nothing remarkable.

CASE II.—Male, seaman. Admitted to Baltimore Infirmary for necrosis of metatarsal bone. The operation was followed next day by incessant vomiting and purging. Evacuations dark and fetid. No pain or tenderness on pressure. On the third day universal jaundice came on. The above symptoms persisted, and patient died sixteen days after the operation. During the last three days the stools were bloody and fetid.

Autopsy: In second curvature of the duodenum near the entrance of the common bile-duct, which was completely obstructed, was a large indurated mass united to the head of the pancreas. Extensive ulceration on inner surface of duodenum. Gall-bladder enormously dilated. Liver extensively diseased and the portal vein completely occluded by the growth. Stomach not diseased.

CASE III.—Male, sixty years. Three years before death began to have uneasiness after eating and later to vomit frothy matter. Finally vomiting became incessant and stercoraceous and pain was felt in the region of the umbilicus.

Autopsy: Stomach dilated five-fold; duodenum enlarged and obstructed six inches beyond the pylorus with an ulcerated encephaloid mass.

CASE IV.—Male, age eighteen years. Foundry apprentice. Good health up to age of sixteeen years; then pain in epigastrium followed by vomiting,

constipation, loss of appetite, emaciation. Seven weeks before death a tumor was discovered just below the costal cartilages on the right side. Five weeks before death he began to vomit large quantities of black coffee-ground material.

Autopsy: A soft, spongy tumor, three by four inches, growing from the posterior wall of the descending portion of the duodenum. The mucous membrane over the tumor was broken down and the lumbar glands enlarged.

CASE V.—Male, age eighteen years. Seven months before death the symptoms began with loss of appetite, vomiting, emaciation, very severe paroxysms of pain. Vomitus was coffee-ground matter, one or two quarts at a time, containing blood, black granular matter and sarcinæ. Became sallow and cachectic. Death.

Autopsy: Stomach dilated. A soft, spongy tumor size of an orange, growing from the posterior wall of the duodenum, covered with a brown slough. Lumbar glands and right testicle were cancerous.

CASE VI.—Male, age seventy-two years. Pensioner. Fourteen weeks before death he began to suffer from vomiting and flatulence following a very hearty meal. Vomiting continued for five days. No pain. Then gradually became intensely jaundiced. Lost appetite, vomited occasionally, became emaciated, but had no pain. Bowels open, stools slightly tinged with bile. No tumor, pain, or tenderness. Liver slightly enlarged. No ascites. Steady loss of strength, occasional vomiting; became comatose and died.

Autopsy: Stomach somewhat dilated. An indurated mass in the duodenum, near the entrance of the bile-duct, ulcerated on the inner surface. Extension of growth into the bile-duct caused obstruction with dilatation of gall-bladder and bile-duct. Small nodules of new growth in the liver. Chronic interstitial nephritis.

CASE VII.—Male, age seventy-four. Laborer. One year before death began to have dyspeptic symptoms. Eight months later a tumor was found in the right hypochondrium just below the liver. He then had extreme constipation, paroxysms of vomiting which continued at intervals for several days, vomitus resembling coffee-grounds. Stomach much distended. Continued to work until three months before death, then became very much emaciated, with a sallow complexion.

Autopsy: A tumor involving the entire circumference of the duodenum for about three inches between the pylorus and the bile-duct. The interior presented an ulcerated cavity. Stomach greatly distended.

CASE VIII.—Male, age forty-five years. Had suffered from intermittent fever seven months before death. This was followed by jaundice and a dull, gnawing, intermittent pain in the epigastric region. Three months before death again had malarial chills. This attack was followed by severe pain in the stomach, frequent vomiting of food and dark grumous blood. Also had hæmaturia. Steadily grew weaker, vomiting incessantly.

Autopsy: A large fungous mass extended from the pylorus to the jejunum, reducing the calibre of the duodenum to the size of a quill. Stomach healthy.

Liver enlarged. Bile-duct distended. Gall-bladder dilated. The common duct contained a large calculus. Omentum slightly involved. No disease elsewhere.

CASE IX.—Male, age seventy-two years. Good previous health. Without apparent cause was taken with jaundice attended with weakness and anorexia. No colic. Jaundice increased. Steady loss of strength. Slight tenderness over liver. No tumor. No ascites. No vomiting. No fever. Six weeks before death had œdema of left arm, then of left leg, then of face. One month before death he became delirious and began to have diarrhœa. Was previously constipated. Œdema then appeared on the right side of the body. Later diarrhœa and constipation alternated. No abdominal tenderness nor ascites. Increasing cachexia. Death.

Autopsy: Stomach healthy. In second portion of the duodenum was a cancerous mass partly obstructing the common bile-duct, which was much dilated above this point. Some cancerous mesenteric glands.

CASE X.—Male, fifty-four years. Six weeks before death was complaining of debility and dyspeptic symptoms, fulness after eating, flatulence, eructations, constipation. One week later he began to have constant dull pain referred to hypochondrium. No special tenderness on pressure or evidence of tumor. No jaundice, nausea, or vomiting. Four weeks before death, began to have frequent large amounts of black, grumous, offensive blood in the stools. Became extremely weak and anæmic. One week before death he began to vomit, vomitus containing a little blood. Urine contained much indican.

Autopsy: An irregular, nodular, scirrhous mass, two and one-half inches in diameter, occupied the middle third of the duodenum. The duodenum just above the mass was perforated. No disease elsewhere.

CASE XI.—Male, fifty-one years old. Family history negative. Habits good. Had pneumonia at age of forty-three. Sickness began October 1, 1887, with vomiting, diarrhœa, and jaundice. Dull pain in abdomen. A few days later a resistant mass, size of the fist, was found in the right inguinal region. The mass disappeared later after free movements of the bowels, but reappeared from time to time. No increase of hepatic dulness, but tenderness in the epigastrium. November 11th, left the hospital much improved but still jaundiced. Returned January 3, 1888, having lost much in strength and weight. Much jaundiced. Constant dull pain in right of abdomen. Frequent vomiting. Bowels loose. No ascites. A resistant, somewhat tender mass was found in the right hypochondrium about size of a lemon. This was aspirated several times during the next few weeks, and small amounts of opaque, thin, watery fluid were removed. Steady loss of strength. Persistent jaundice, bowels loose. Moderate increase in size of liver. March 23d became delirious, and on the 27th after an intestinal hemorrhage of eight ounces, died.

Autopsy: The upper two inches of the duodenum dilated to twice the usual size. At orifice of the bile-duct was a growth size of English walnut

with a papillary surface covered with clots. Gall-bladder was size of fist, wall much thickened, containing thin pus. Liver enlarged one-third and contained numerous small abscesses corresponding to the distribution of the bile duct.

CASE XII.—Seen in consultation with Dr. Charles D. Swain, of Charlestown, to whom I am indebted for the following history. A. M., age sixty-six; married; occupation, carpenter. First saw him March 12, 1888, and obtained the following history: Had been for a year under treatment of several different physicians, "for dyspepsia," he said. When I saw him he was able to walk about the house, but did not care to venture out of doors. At the time complained of failing strength, rapid emaciation, and inability to keep any food on his stomach, though there was a constant desire for food. The vomiting occurred generally from one-half to three-quarters of an hour after taking nourishment and even water; the vomitus made up simply of ingested substances, and very offensive. No blood ever seen. Constipation had, during all of his sickness, been a prominent symptom. In connection with the vomiting, would state that there was no retching. No abdominal pain, but slight tenderness in epigastrium.

Physical signs. Pulse normal and about 70. Chest: Heart sounds feeble, no murmur. Lungs normal. Hepatic dulness not increased, but in doubt as to whether left lobe of liver enlarged or not. Skin, lemon color at the last. By palpation, still more in doubt as to whether a tumor could be felt. Abdomen retracted, and never distended during the whole course of the disease. Milk and lime-water only, by mouth in one-half ounce amounts. Brandy, egg and milk, by enema. Bismuth and hydrocyanic mixture by mouth. Salicylic acid for gaseous eructations. Gradually failed, and treatment was of no avail. Never complained of pain, and died from exhaustion on April 19th. Emaciation extreme.

Autopsy: April 20th. Body extremely emaciated. Abdomen retracted to an extreme. Skin flabby and lemon-yellow in color. Stomach contained about six ounces of yellow, thin, and offensive fluid; not dilated to any appreciable extent. Duodenum in its first and descending portions, including the whole circumference of the intestine, a hard, smooth (gristle-like) tumor, elongated, its thickest portion being near the pylorus. This tumor was four to five inches in length and involved the three coats of the intestine, the canal being almost completely obstructed and could not be distended. The mucous coat ulcerated and villous in character and hemorrhagic. The wall of the intestine at its greatest thickness about three-quarters of an inch.

I am under great obligation to my friend, Dr. Robert Burns, of Plymouth, N. H. for the accompanying specimens, and the history of the following case:

CASE XIII.—G. F. D., of healthy antecedents and good family history, age thirty-three years. No illness of importance up to one and one-half years previous to his death, then and during the rest of his life "indiges-

tion," nausea, and great discomfort. About a year before his death, vomiting began and continued with short intervals, but during the last four months it was the prominent symptom, ejecting enormous quantities, two to three quarts at a time, and often ten to twelve quarts in twenty-four hours; this vomiting varied in time from soon after eating to several hours; much of the tissue of the vomitus was green as if Paris-green had been mixed with it. All of the time he was greatly constipated. He had no localized and no excessive pain. He had great discomfort, and sensations of weight and oppression referred to epigastric region, but pain when present, varied in its location, in different parts of the abdomen. There was no marked cachexia, nor was the abdomen shrunken or depressed. No tumor could at any time be made out. The physical signs were of moderate epigastric distention, and excessive gastric dilatation. He died from exhaustion.

Autopsy showed marked emaciation. Stomach and small intestine for about eight inches greatly dilated, to such a degree that there was no essential difference in size between the stomach and the first six or eight inches of the duodenum. The line dividing the stomach and the duodenum could not be marked out. About eight inches below the stomach was an annular constriction, below which the bowel was much diminished in size and nearly empty. At the point of constriction the small intestine was completely obstructed by a fungoid mass, which acted as a valve; water would not pass down from above, but a pencil could be pushed through from below. There was no evidence of disease elsewhere in the body. The symptoms were "indigestion" for one and one-half years, vomiting during the last six months of enormous quantities up to the day of his death, and death from inanition.

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CASE

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X. *Dr. J. L. Hicks:* New York Med. Record, 1878, xiv. 67.

XI. *Dr. A. L. Mason:* Boston City Hosp. Records B. C. H. (unpublished), cclxiii. 26; cclxv. 154.

XII. Unpublished.

XIII. Unpublished.

Other cases are reported by Murchison, Leube, Tauchon, Descraizilles, Hamilton, Molinelli, Williams, and Dixon.

PRIMARY CANCER OF THE GALL-BLADDER AND BILE-DUCTS.

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STIMULATED by the unfortunate but unavoidable result of laparotomy in the last of the cases about to be reported, with a long-time interest in the success of surgical measures for the relief of obstruction of the biliary passages, the writer was led to the study of the recorded cases of the forms of cancer indicated in the title.

One hundred cases of primary cancer of the gall-bladder and eighteen cases of like disease of the ducts have been analyzed. In addition, a brief note is made of three cases of sarcoma of the gall-bladder, abstracts of which are added. The cases of Burridge and Tyson, referred to by others, have been excluded because of the strong probability of their secondary nature.[1] The two cases of Hayem and one each of Chassaignac and Boucherau,[2] included in Villard's table, are not in this list. Heschl, in the report of a case, speaks of two cases with gall-stones which he had seen; Fagge summarizes twelve cases; Marchand reports one, and Fazio refers to another in his report. Moore has studied ten cases, four of which only are placed in the present collection. In the St. George and St. Bartholomew Hospital Reports descriptions of lesions in two cases may be found. The five cases of Prof. Stiller were secured too late for classification. The five cases of cancer of the bile-ducts reported by Prof. Delafield are not included in the second tables because they were reported collectively. Finally, no attempt has been made to include any of the cases referred to in a more or less general manner by the systematic writers on pathology or internal medicine—Rokitansky, Förster, Klebs (two

[1] Burridge: Cancer of breast some years previous. Tyson: Epithelioma of lips; last removal one year before death.

[2] Hayem: Female, æt. 52; male, æt. 56. No detailed account of cases of C. and B.

cases), Birch-Hirschfeld, von Schueppel, Frerichs, Bartholow, Loomis, Murchison, and others.

It is thus seen that, in addition to the cases tabulated by the writer, thirty-three cases of primary cancer of the gall-bladder and five of the ducts have been placed on record in a more or less tangible form, while doubtless a large number have been observed in our large hospitals that were never publicly noted.

A collection of 159 cases disabuses one of the idea of an affection being rare, and yet systematic writers always refer to the great rarity of primary cancer of the biliary passages. Ranvier and Fagge declare it to be much more common than it is usually considered, and that its presence is mistaken for carcinoma of the liver. One source of fallacy is mentioned by the latter writer, viz., that cancer of the gall-bladder growing into the hepatic tissue is called cancer of the liver, because the gall-bladder, in the centre of the tumor, is overlooked on account of its small size. Again, we fear it is not customary to explore the ducts with that accuracy which is essential to determine the presence of small new growths.[1]

The frequency of this form of primary cancer, compared with its frequency in other organs, may be inferred from the statistics of Norman Moore, in the latest Bradshawe Lecture.[2] He details the results of the examination of one hundred and twenty-nine cases of new growths in the internal organs of the body, studied during a period of several years. Ten cases in which the gall-bladder and large bile-ducts were the seat of new growth are noted. Compared with the number of cases of like affection in other organs, collected during a similar period, it is not an insignificant number. The internal organs which are the common seat of primary new growths are the stomach, the œsophagus, and the uterus. Twenty-nine cases of cancer of the stomach and fifteen of the œsophagus were observed by Moore. Eleven new growths in the lung, eleven in the pancreas, nine in the colon, eight in the rectum, and fewer numbers in other organs, show that primary cancer of the biliary passages is much more frequent than we have been led to believe. Uterine cancer was not studied by Moore.

[1] See also Orth, Diagnosis in Pathological Anatomy, Boston, 1880, pp. 307 and 330. Orth says it can be easily overlooked, and that so-called primary cancers of the liver are frequently secondary to cancers of the biliary passages.

[2] On the Distribution and Duration of Visceral Growths. Bradshawe Lecture, London Lancet, vol. ii. No. 9, 1889, p. 415.

It is not without interest to refer to the fact that the literature of primary cancer of the biliary passages is quite recent. Villard, in 1872, published the most complete paper on the subject. He was unable to collect more than twenty-five cases up to that time. Since then Kohn, Kraus, LangHeinrich, Zenker, Bernheim, and Stiller have made the most important contributions. Prior to 1872, the subject seemed to attract the attention of the French writers chiefly; since then the Germans have taken precedence, although Fagge and Moore, Habershon and Murchison, in England, have made careful studies of it.

The following cases were observed by the writer; one of them was previously reported, but the interest of the case warrants a reprint of it:

CASE I.[1] *Primary cancer of the gall-bladder. Pain in the right hypochondrium; jaundice; enlargement of the liver; absence of tumor; fever; vomiting; diarrhœa; death from exhaustion.*—Mrs. McM. was under my care from the 9th of March until the 4th of May, 1881. Her illness dated from the middle of December, 1880, and continued until the 18th of May of the following year. The history previous to my attendance was apparently that of an intermitting fever, with hepatic and gastric complications. The symptoms referable to the liver were paroxysmal lancinating pains in that region, at times so severe as almost to cause collapse. The gastric symptoms were epigastric pain, loss of appetite, flatulence, acid eructations, and, at variable intervals, attacks of vomiting. She had not been jaundiced.

I found her suffering from an intermitting fever with daily paroxysms, each beginning about 1 P. M., and continuing until 7 or 8 P. M. The chill lasted a half-hour, and was moderately severe; the fever lasted four hours, at its height the temperature being 103°. She was emaciated; her features indicated exhaustion, and were somewhat pinched; her complexion was sallow; she was anæmic. She suffered from severe paroxysmal pains in the epigastric and hypochondriac regions. The areas were tender on pressure, but no tumor was noticed. The liver-dulness extended three inches below the ribs in the nipple-line. The spleen was twice its natural size. The appetite was lost. She had nausea, acidity, and flatulence. The bowels were constipated. Urine contained neither albumen nor sugar. Urates and uric acid were in abundance.

During the course of her illness the symptoms may be detailed under three headings: febrile, gastric, and hepatic. There seemed to be no relation between the different sets of symptoms, except the febrile and hepatic. The fever was more continuous when the jaundice was deepest. At the risk of some repetition, I will note them.

[1] Trans. Path. Soc. Phila., vol. x., 1873, p. 81.

Gastric.—Tongue covered with a dark-yellow, heavy fur, moist, tremulous later, dry and brown. Bitter taste in the mouth, secretions viscid; loss of appetite; thirst; acidity; flatulence; weight and fulness after meals; epigastric pain and tenderness, nausea, and vomiting. The latter, of all the gastric symptoms, was especially independent of any other symptoms. It occurred once in two weeks, once a week, or twice a week. Each paroxysm lasted from two to four days. The fluid vomited varied from a clear-white, sour, to a greenish-yellow, bitter liquid.

Hepatic.—Pain in the right hypochondriac region, paroxysmal, sharp, and lancinating, radiating to right and left shoulders and to epigastrium; tenderness on deep palpation, absence of tumor or irregularity of edges; enlargement as noted above. On account of liver derangement, there was marked jaundice, with clay-colored stools and bile in the urine. The jaundice occurred four times while the patient was under my care. The first attack was light, lasting three days; the second and third each lasted a week; the fourth, beginning on the 25th of April, continued till death. Each attack was preceded by hepatic colic. With the second and third attacks the fever was remittent in character; with the last it was continuous. As the jaundice improved, the fever changed from the remittent to the intermittent type.

Febrile.—As may be inferred from the previous notes, the fever was irregular. At first it was intermitting, then remitting, and, finally, it became continuous. At no time was the temperature higher than 104°. With the rise in temperature there was a corresponding pulse-rise. The increased pulse was not as great, by twenty beats, as a pulse at the height of a paroxysm of intermittent fever. The last month of illness it became rapid, feeble, compressible, and dicrotic. When the fever was remitting or continuous, in the evening there was delirium. The "typhoid" state developed the last ten days of her life, and death took place from cardiac failure. The use of antiperiodics prevented the paroxysms at first. As soon as the drug was suspended they recurred. Finally, in spite of my remedies, the fever continued.

The following facts also bear upon the case: The patient was a married woman, who had not lived with her husband for several years, on account of his brutality. She was thirty-seven years old, a nurse by occupation. She had always been in poor health, and had had several attacks of biliary colic. The family history was good, save that a maternal aunt died of cancer. Her mother and brothers were living; her father had been killed.

Autopsy.—Rigor mortis had set in early; the body was greatly emaciated, and all the tissues were stained with bile. With the exception of the liver and spleen, the organs were normal for a person who had died of heart-failure. The spleen was about twice the normal size, of a dark, greenish-brown color, and of about normal consistence. Unfortunately it was not examined microscopically.

The liver was of peculiar shape. The right lobe was eight inches long, the left the same. Curiously, however, the lower edge of the lower lobe did not extend as low down as that of the right lobe, but its upper edge was three and

one-half inches beyond the same edge of the right lobe, while the lobe was doubled on itself to conform to the concavity of the diaphragm. Transversely, the right lobe measured five and one-quarter inches; the left three and one-half. The former was two and one-half inches thick, the latter one and one-half. The gall-bladder was in the normal position and of the normal size. It was adherent to the duodenum. The color of the outer portion was pure white, not bile-stained. It was not collapsed, and was of firm consistence. A portion of the bladder underneath the liver, not quite as large as a walnut, was of natural color, and exhibited fluctuation.

On section of the gall-bladder, it was found that the white appearance of the exterior was due to cancer, which involved three-quarters of the organ. The growth encroached upon the cavity so that the walls were from one-half inch to one inch thick. The mass had the appearance of a soft cancer; the inner surface had a ragged, ulcerated appearance, and in the centre of the mass was found a gall-stone the size of a filbert, with a rough surface looking like a mulberry calculus. The stone was lying against the mouth of the gall-bladder; behind the stone was a cavity about the size of the stone filled with a thick, greenish-yellow fluid. From the appearance one would infer that the stone acted as a ball-valve to the duct, and its presence was the cause of the attacks of hepatic colic during the course of the disease. The hepatic duct was enlarged, its walls thickened, its calibre much increased. The branches extending into the upper half of the right lobe were greatly dilated, even almost to the periphery of the liver, terminating in saccular dilatations. The ducts contained a thick, grayish-green matter; the walls were of a slate-gray color, dotted with dark points. The liver substance traversed by these ducts was dark and soft, not unlike gangrenous tissue. A part in the centre, about three inches square, was especially of this appearance. The remainder of the structure of the organ was slightly stained with bile and fatty in appearance. On microscopic examination the malignant mass was found to be of the nature of a medullary cancer. The cystic and part of the hepatic duct were involved. The transition from the cancerous to the catarrhal process in the ducts was well marked. In the liver catarrhal inflammation of the ducts was very distinct. In the lymphatic spaces around the ducts there was an abundant infiltration of epithelioid or indifferent cells. The cancer of the gall-bladder was no doubt primary, from the ragged appearance of the mass and the absence of nodules.

CASE II. *Primary cancer of the common gall-duct. Jaundice; vomiting; fever; epigastric pain; tumor. Laparotomy. Death from peritonitis. Cancer of the bile-ducts; secondary cancer of the liver and pancreas.*—M. H., aged forty-nine, male, family history and habits good.

Previous history.—One year ago, in July, 1887, he was taken sick with cramp in the stomach and vomiting; jaundice, associated with intense itching, gradually developed, and reached its height in December. In January he had an attack with all the signs of "typhoid fever." The jaundice continued during the latter part of the winter and spring. During the spring there was

epigastric tenderness and soreness, and the same sensations in the region of the gall-bladder.

Treated in the Presbyterian Hospital from May 17 to June 13, 1888, for cirrhosis of the liver. At that time he was extremely jaundiced, fairly well nourished, abdomen swollen, appetite poor, bowels constipated, and he had paroxysmal pain in the region of the gall-bladder. He improved while in the hospital, but took cold on his way home in June, and had chills and fever with a return of the jaundice and epigastric pain. On August 17th he had chills, beginning about 3 P. M. and lasting sometimes until midnight. Had fever, no pains, but constipation; after the relief of the latter he affirms that the chills disappeared, and that their occurrence was sometimes preceded by distention of the abdomen.

October 3, 1888. On readmission to my wards in the Presbyterian Hospital the following notes were taken: Slight emaciation, general jaundice, no œdema, no itching, anæmia; no general distention of the abdomen but distention of the epigastrium to one and one-half inches above the plane of the umbilicus; right hypochondrium fuller than left; a rounded prominence the size of a dollar, movable with respiration, is opposite the umbilicus in the right nipple line. Its lower border is well defined on the left side, smooth and tense, and its upper and right border is continuous with the liver, which is full two and one-half inches below the margin of the ribs. The edges of the liver are smooth and somewhat thickened. Inside and to the left of the previously described tumor the liver border runs parallel with the ribs, and two and one-half inches below it, to the median line. Upper border of hepatic dulness in right nipple-line at fifth rib; in axillary line, at seventh rib. No gastro-intestinal symptoms.

8th. On aspiration of tumor, serum containing albumen withdrawn; gradual loss of appetite.

15th. Laparotomy. Death from peritonitis in forty-eight hours.

Autopsy (abstract).—Thickening and occlusion of the common and hepatic ducts by carcinoma, which is undoubtedly primary. Secondary nodules in liver, especially on under surface; chiefly peritoneal. No other secondary nodules except two in the head of the pancreas.

Gall-bladder enlarged and contained sero-purulent fluid, but no gall-stones. All organs presented an appearance due to chronic jaundice.

Résumé.—Chronic jaundice, epigastric pain, improvement; relapse, with intermitting fever, enlarged liver and gall-bladder containing serum. No gall-stones.

PART I. PRIMARY CANCER OF THE GALL-BLADDER.

One hundred cases form the basis of these studies. In sixty-four cases the variety has been clearly indicated. Twenty-three were of the encephaloid, nineteen of the scirrhous, six of the colloid, and four

of the villous form, and twelve were cylindrical epitheliomas. In thirty-six cases the type was not noted.

MORBID ANATOMY.—The gall-bladder has been described as reduced in size (eighteen), or of normal size (two), enlarged (ten), dilated (six), or enormously dilated (seven).[1] The terms used to describe the size represented the objects—hazel-nut, pear (three), apple, goose-egg, two fists, hen's egg, two eggs, child's fist, man's fist or hand, child's head, turkey's egg. The changes in size depend on the variety and seat of the new growth. The well-known appearance of each variety need not be detailed. If the fundus or the walls are involved, as a whole or in part, a nodular mass or masses—small and contracted if scirrhous, large if encephaloid; hard and dry if the former, soft and juicy or pulpy if the latter—are seen. The usual secondary changes, softening, etc., were noted frequently. When the growth invades the neck of the bladder as an annular ring or an outgrowth or a node, causing stenosis of the orifice, the remainder of the organ may be either atrophied or much dilated. A growth situated at the neck was particularly detailed six times, and at the fundus an equal number of times. Nine times the mass was said to be hard, or firm and rough, or nodulated. The gall-bladder was "destroyed and replaced by new growth" in twelve cases; inclosed in the growth in three; not distinguishable in one; a soft, whitish pulpy mass in one; and destroyed by cancerous ulceration in one instance. Presumably in these instances the growth was of least firmness. Certainly in the following cases the firmness or hardness was undoubted—when the walls were infiltrated (four), or thickened (nineteen), or "converted into a solid mass" (one). In three instances the mass was composed of pouches, and in many instances one or more pockets, the remains of portions of, or the entire gall-bladder, are described. In one case a membrane subdivided the sac into two portions.

Six times simple ulceration of the interior of the gall-bladder is described; twice ulceration with perforation into the peritoneal cavity; six times with perforation into the duodenum; and ten times with perforation communicating with the colon.

Adhesions to surrounding organs are common, and, excluding adhesions with perforation, are as follows: to the duodenum (five), the

[1] The numbers represent frequency of occurrence of each condition.

colon (four), the stomach (four), the round ligament (one), the liver (two), the liver and stomach (one), the vertebral column (one), aorta and vena cava (one). General adhesions were noted in one. In one instance the growth turned the vena cava out of its course, and in one compressed the hepatic artery and vein.

The contents of the gall-bladder or its pouch varied. Gall-stones were present in sixty-nine cases, and noted as absent in three. In twenty-six cases the contents were fluid, mucus (seven), pus (seven), bile (two), blood (one), liquid-like serum, thin watery fluid, green watery fluid, clear white, thick fluid, thick, gray fluid, encysted fluid, one each (all mucus or mucoid); once each sanious, grumous, or meat-broth-like, and once it was simply noted as "fluid;" in one case "plaster-like" contents were found.

The extraordinary frequency with which gall-stones are found has been mentioned by all writers, while many believe they are often present but overlooked. They are seen free in the cavity of the affected bladder; free or fixed in pouches or diverticula, so called, the walls of which are normal or the seat of disease; imbedded in the malignant mass, or filling the lumen of the ducts. In one instance one was found in the fistulous communication between the liver and the colon. They have been distinctly referred to as old stones by some of the writers. Ord alone reports a calculus which, from its chemical nature, could be inferred to be of recent and non-biliary origin. It was composed of carbonate and phosphate of lime and altered mucus, and did not contain bile elements. The relation of the calculi to the new growth will be discussed later.

Liver.—One would naturally look for secondary changes in the liver proper, and yet, save by metastasis, its structure was but infrequently changed.

Size noted as normal (five), small or atrophied (four), enlarged (fourteen), double the natural size (two). It was the seat of secondary deposits fifty-four times, in two of which the invasion was particularly stated to be by contiguity.

In a large proportion of cases the invasion undoubtedly was by contiguity, and the progress along the ducts has been particularly described. In Willigk's case the induration about the ducts extended "tree-like" into the structure of the liver. Multiple hepatic abscesses were present in two cases.

Bile-ducts.—The changes in the ducts are due to the presence of secondary growths, or to the "growth of continuity" (a term insisted upon by Moore) of the neoplasms, to obstruction of their lumen, or to secondary catarrhal or purulent inflammations.

Hepatic Duct.—Noted normal in five, dilated in twenty-one, the seat of secondary disease in thirteen, and of purulent inflammation in three instances. Obstruction and compression were each present in one instance, and a gall-stone was found in one.

Cystic Duct.—Normal four, and dilated thirteen times. In one exceptional instance it was dilated to the size of the transverse colon, and contained gall-stones. Six times it was obliterated, once each narrowed, closed, or impermeable, and four times obstructed. Twelve times it was the seat of secondary growth, twice indurated and thickened, and three times inclosing gall-stones.

Common Duct.—Normal eight, dilated eleven, the seat of secondary growth seven, and obstructed seven, times—by pressure four, not known two, stone one. The duct was obliterated three times, was thickened once, and contained calculi three times, and pus and blood and "fluid" once each.

Metastasis.—This was noted as present in fifty-five cases; in every instance but one the liver was one of the affected organs. The cases in which the growth in other organs—the duodenum, colon, lesser omentum, and peritoneum—took place by direct continuity are not included.

The cases of extension by continuity include the ones in which ulceration and perforation of the hollow viscera—the duodenum and colon—took place, and of ulceration and fistulous communication of the gall-bladder with the abdominal walls—the only one of the kind reported.

The frequency with which the various organs were found to be the seat of isolated secondary growths is as follows: Abdominal lymphatics (sixteen), mesentery (four), omentum (five), duodenum (four), colon (three), peritoneum (three—two if omentum and mesentery are included), stomach (six), pancreas (three), lungs and pleura (ten), supra-renal bodies (two), and once each in the mediastinal glands and the ascending colon. In one case, in addition to secondary growths in the stomach, liver, pancreas, and peritoneum (included in the above),

they were found in the navel, rectum, uterus, and kidney. It was the only case of the almost universal presence of the disease.

It is thus seen that secondary growths are not common, and are not universal or found in distant parts. It is impossible from this series of cases to prove the first conclusion of Moore (*loc. cit.*) that carcinoma of the gall-bladder and large ducts usually grows directly into the liver. The second proposition, that secondary deposits are not widespread, is supported, but the order of frequency must be reversed in the third conclusion. In the following, named in the order of greatest frequency from the first, metastasis occurs—to the liver, the abdominal lymphatics, the peritoneum, the lungs, the stomach, the duodenum, and to the pancreas. These estimates, as all that are made in this paper, of course are relative only, and subject to the same valuation that one gives to any collection of facts the correctness of which depends upon various judgments and observations. Care has been taken to prove the facts in each case.

To conclude: In primary cancer of the gall-bladder one finds the organ most frequently diminished in size and hard, or of normal size; sometimes (in 20 per cent. of the cases) it is enlarged. The enlargement is generally due to dilatation, and then the mass projects beyond the margin of the liver. Gall-stones are found in 69 per cent. and fluid contents in 26 per cent. of the cases. Extension by continuity or by secondary deposition takes place in about 75 per cent. of the cases, although it is never widespread. Adhesions form in 20 per cent., and adhesion with ulceration and perforation takes place in 18 per cent. of the cases.

ETIOLOGY.—No facts can be deduced from these cases to aid us in the formation of a theory of the etiology of cancer. Certain positive relations of probable cause and effect can be pointed out, while in this particular location of carcinoma its greater frequency in the female sex is established.

Of the influence of heredity or occupation, or hygiene, food, drink, or personal habits, climate or country, nothing can be learned. The cases occurred almost entirely in hospital practice, and thus a general notion of the character of the individuals can be formed. The frequent reports of cases from this class are due to the fact that private cases are never so well studied, from the nature of things.

Age.—In ninety-one cases the age is recorded. An average of the

ages would not be strictly accurate; a statement of the frequency in different decades gives the best notion of the period in life when the disease is most frequent:

1 to 10 years	1
10 to 20 "	0
20 to 30 "	1
30 to 40 "	9
40 to 50 "	19
50 to 60 "	27
60 to 70 "	19
70 to 80 "	14
80 to 90 "	1
Unrecorded	9
	100

The largest number of cases occur from the fifth to the eighth decade inclusive, and in the sixth decade the largest number in any one similar period is found.

Of sixty-four cases, in which the variety is recorded, the ages of sixty are given. No variety preponderates in any particular decade. Some (five) of the encephaloid type occur a decade sooner (30 to 40) than the scirrhous, but they continue as late in life as the latter (70 to 80), and one was found as late as past eighty. Five of the six colloid carcinomas were found between sixty and seventy. The youngest case, reported by Dr. Moxon, was in a patient aged four years. It was a villous carcinoma. Curiously, the earlier cases reported occurred after sixty, and hence the conclusion arrived at and adopted by systematic writers was, that the disease occurred late in life. Thus, in Villard's table, of twenty cases in which the age is given, nine patients were over seventy, and five between sixty and seventy. Of our cases 57 per cent. of the entire number were under sixty years of age. The average of Kohn's cases was 57.7 years. Hess states the average age of carcinoma of the liver to be 45.4 years. Cancer of the gall-bladder probably occurs frequently later in life than carcinoma of other organs, but not so late as formerly thought; and, indeed, when one compares this table with the one of Welch, in his article on Cancer of the Stomach (*System of Medicine*, Pepper, 1886), one sees not much difference in the age of patients with the two forms of cancer under consideration.

Sex.—The sex of ninety-eight of the entire list is given—twenty-three males and seventy-five females. The ratio of males to females

(eleven females to seven males) is more nearly equal in the scirrhous variety than any other. All of the colloid variety occurred in females. Otherwise there is no significance in the sex of the persons in which the respective varieties occurred.

The enormous preponderance of females has always been recognized and commented upon, and, in connection with the frequent association of gall-stones, is considered a marked etiological factor. Certainly it is a valuable clinical index.

Gall-stones.—One school of pathologists believes that the stones precede and are the exciting cause of carcinoma of the gall-bladder in a predisposed individual—Durand-Fardel, Klebs, von Schueppel, Villard, Murchison, Frerichs, Kraus, Ranvier, Zenker, Stiller, Fagge, and others.

Another believes that the stones are formed secondarily to the new growth—Lutton, Förster, Davaine, LangHeinrich, etc.

Calculi were found in sixty-nine cases; they were noted as absent in three. Zenker believes they are often overlooked. Their absence at the autopsy does not indicate necesarily that they had not been present in life; they may have escaped by ulceration. Scars or ulcers often are found, which indicate that stones had been present before death. A single stone with facets was found in Wiggleworth's case, without perforation. The others must have escaped during life. In one of Zenker's cases fragments of calculi were found.

Because calculi are so common in females, and cancer of the gall-bladder largely in excess in that sex, it was thought by the early observers that the former induced the latter. Gall-stones undoubtedly occur more frequently in persons who die from cancer of internal organs than in persons who die from other causes. The diathesis favors their formation, and Kohn particularly urges the fact that the cancerous diathesis creates such relaxation of the tissues as to favor the stagnation of bile. He believes the two conditions are in progress at the same time.

If the calculi are an exciting cause, they must precede the formation of the carcinoma. Three cases of carcinoma are reported in persons who had been the subjects of hepatic colic for a long time previously. Klebs found an old stone, with commencing carcinoma, in the neck of the bladder. He thinks it positive evidence that the foreign body was the exciting cause.

Some anatomical evidence seen at the autopsies throws light on the subject. Stones are found in the bladder, the duct of which is and has been obliterated for some time. They are often in large numbers, surrounded by mucus and old lymph, bathed in pus, or covered with serum. No traces of bile have been found in the same sac. They are found in pouches surrounded by healthy walls cut off from the bile-duct, or fixed in the new-growth structure. The gall-bladder cavity usually diminishes in size so that it is not a large enough reservoir for calculus formation, while shrinkage is seen in cases where the cancer does not contract. In a number of cases the cystic duct was obliterated, and yet stones were in the gall-bladder. Gall-stones are found in the ducts outside and beyond the seat of disease, and yet must, from their appearance, have formed in the gall-bladder and passed out. The case of Quetsch shows that gall-stones preceded the carcinoma, for they had been discharging from a biliary-cutaneous fistula for three years.

In the remarkable case of Goodhart, in which the cystic duct was enormously dilated and contained a great number of calculi, which developed with the cancer, the evidence seems to favor the idea that gall-stones form most rapidly in cancerous subjects. No facts have been brought forward to prove the formation of gall-stone after cancer. Ord's case alone shows the presence of a post-cancerous calculus which, however, was not biliary. The problem seems to stand about as follows:

Gall-stones are found in cancer of the gall-bladder. The clinical history and the anatomical appearances appear to show that they formed prior to the formation of the cancer.

Cancer occurs without gall-stones, and, *vice versa*, gall-stones occur without cancer. The frequent association of calculi and carcinoma, and the undoubted fact of their formation prior to the morbid growth, warrant the belief that their presence is as much a causal factor as are irritants in other situations, *e. g.*, in the lips, etc.

In objection to the view that gall-stones have a causal relation to carcinoma, some urge that such relation does not exist under like circumstances with calculus of the kidney and urinary bladder. One must remember, however, that the mucous membrane of the gall-bladder is richer in glands than the same structure of the pelvis of the kidney or the bladder, and hence more likely to invite an irritation

resulting in carcinoma. Zenker believes an adenoma develops by irritation and that it changes into an adeno-carcinoma, which is the primary atypical growth. Then again, the irritation of a gall-stone may continue silently for years, while a calculus in the kidney or urinary bladder is soon the cause of such deleterious secondary changes that the health is impaired before a carcinoma can arise.

Among other causes considered are local external injuries, as by a blow (Robinson and Fitzgerald), or a fall (Moxon's case), or the irritation produced by tight lacing. Marquand reports a case of the latter. The depression of the ribs crosses the liver and ducts, and in the illustration accompanying the report of his case, the bladder is seen to be constricted. In this constricted portion the disease began. The patient of Robinson and Fitzgerald had been kicked seventeen years before death. From then until his final illness he was subject to pain in the right hypochondrium. The local peritonitis and inflammation was no doubt a predisposing factor. In Martin's case, after a fall on the right side, symptoms of biliary obstruction and carcinoma began.

SYMPTOMS.[1]—The most frequent symptoms and signs observed in the course of carcinoma of the gall-bladder are pain, jaundice, emaciation, cachexia, and the presence of a tumor. Digestive troubles, vomiting, constipation, diarrhœa, fever and ascites occur in a considerable number of cases, and are worthy of detailed study.

Pain.—This is a symptom the presence of which was noted sixty-two times. It was located in the right hypochondrium twenty-five times; in the epigastrium, seventeen times; in the abdomen, nine times; in the hepatic region and the right side, four times; in the right shoulder, three times; in the back, twice; in both hypochondria, and at the umbilicus, once each. It was associated with tenderness in the right hypochondrium or liver, nine times, and was increased by movement or position. In nine instances it was colicky; in three, lancinating; in four, paroxysmal; sixteen of varied character; in three instances, dull; and in four constant. In two instances pain unqualified was noted, and in two it was noted as

[1] It should be remembered that in a small percentage of the cases, particularly those of Zenker, there is no record except of the autopsy. It may be assumed, therefore, that the symptoms noted below occurred more frequently than the numbers I have given indicate.

absent. In a very large proportion of the cases the pain was preceded by a sense of weight or uneasiness in the right hypochondrium. Certainly the pains increased in frequency and severity as the disease progressed. The abdominal pain above noted was due in nearly every instance to peritonitis, so that practically pain in the right hypochondrium or epigastrium of a colicky or lancinating nature is seen in the larger number of cases of cancer of the gall-bladder.

Jaundice.—Reported in sixty-nine cases. Characterized as slight in six cases; transitory, in one; recurring, in one. In fifty-eight instances, however, the jaundice gradually increased in severity until it presented the characteristic olive-green or deep yellow appearances of chronic icterus. In a few instances it developed less than one month before death, and in three less than three months. The jaundice was due to the new growth in the ducts, the presence of enlarged glands, or to catarrhal or purulent inflammation, or the results thereof, *i. e.*, adhesion of the walls. In two instances stones were impacted in the common or hepatic duct, and in one instance the hepatic ducts were dilated on account of the passage of a gall-stone a few days before death (Kohn). Accompanying the jaundice in its final stages, delirium in three, and coma in five instances were observed. Itching is noted three times.

Emaciation.—Distinctly noted forty-four times, but no doubt much more prevalent, as will be seen later. Death often took place from acute complications before the disease had progressed very far. In Wagner's case the flesh was preserved; the patient (a woman) died of peritonitis. In twenty-two cases debility, weakness, or exhaustion are recorded.

Cachexia.—Noted in fourteen cases. The deep jaundice prevented the recognition of the characteristic cachexia very frequently, no doubt.

Vomiting.—Due to catarrhal gastritis, to pressure of external growths, or to secondary growths in the viscus, occurred in thirty-nine instances. Usually of the ordinary character, in three instances it was bloody, in one stercoraceous (LangHeinrich's, perforation of gall-bladder and colon, peritonitis). In Pepper's case there was bilious vomiting, no jaundice, and no bile in the stools. Pressure on, and occlusion of, the duodenum by the enlarged gall-bladder caused these phenomena. In two instances nausea without vomiting, and in five with it, took place.

Diarrhœa was present in fifteen cases, *constipation* in twenty-three. Diarrhœa occurred more frequently from other causes than perforation of the colon, as intimated by some.

The *appetite* was lost in fifteen instances, and *indigestion* marked in thirteen cases. These figures are small, no doubt, for these symptoms. Hiccough is recorded four times, ptyalism once, and dysentery once.

Fever. — The temperature was subnormal, or more frequently normal; eighteen had marked fever, in some a few days before death only, in others as long as one to four months. In three instances it was distinctly intermitting In every instance it was due to some complication, either inflammation of the bladder or ducts, peritonitis, or ulceration. If, therefore, this symptom arises in the course of the suspected disease, it is due to one of these causes. It could be due to a calculus impacted in the duct, no doubt, although such circumstance was not reported.

Ascites was noted in eighteen cases, and was almost always due to pressure on the portal veins, either by the primary growth or the lymphatic glands. In twelve instances there was œdema of the legs, and in two anasarca.

Hemorrhages were noted in seven instances. The hemorrhages were due to passive congestion from local obstruction, or to secondary growths, or were of the nature of such discharges in chronic jaundice, and occurred from mucous surfaces remote from the disease.

Tumor.—Sixty-eight times a tumor was discovered.

The following numbers represent the frequency of location in the positions indicated:

In the right hypochondrium or gall-bladder region . .	27 times.
Attached to the liver	10 "
In umbilical region	12 "
In the iliac fossa	4 "
In the flank	2 "
Near the pylorus	1 "

The positions of most frequent occurrence are, therefore, the right hypochondrium and the umbilical region. All the tumors that occurred in the umbilical region were thus placed because of enlargement of the gall-bladder, or enlargement of the liver. If the latter organ is en-

larged, a tumor in the umbilical region, particularly to the right of the median line, is probably an enlarged gall-bladder.

The size of the tumor was noted only thirteen times. From the descriptions one concludes that the organ was seldom larger than normal. It was said to vary in size from a hazel-nut to a child's head; of the latter three instances are recorded. In the course of the disease it may change. This is especially true if fluctuation has been previously detected. By ulceration the contents are discharged and the tumor disappears. One disappeared after a copious emesis of mucus and bile, the temporary occlusion having been removed. Sometimes they disappear temporarily on pressure (one case).

The tumor was movable as above or with respiration (two), movable on palpation (six), fluctuating (three), fixed (six), elastic (two), solid (eleven), smooth (three); in twenty-two instances hard or firm; in twenty-one painful or tender; in nine irregular, three of which are noted above among the "hard," and the remainder are presumably hard. Practically the tumor was movable in eight instances and fixed or firm in about fifty cases in which the character is recorded.

The shape was noted ten times: round (five), oval (one), pyriform (two), cylindrical (one), oblong (one). Two of the tumors are described as growing rapidly.

We may conclude, therefore, that a tumor in the right hypochondrium, or occasionally in the umbilical region, about the size of the fundus of the gall-bladder, hard and painful, and of indifferent shape, is found in cancer of the gall-bladder.

Liver.—During life the liver was found to be enlarged twenty-nine times, five of which times it was irregular or nodular, and four times it was of the same character, the size not being stated. The border was thickened (one), smooth (four), hard (three), and the surface tender (four). No significance attends change in the liver except enlargement. This is due to secondary growths or to dilated channels.

The clinical picture, therefore, of cancer of the gall-bladder is about as follows: The patient, usually a female past forty years, suffers for an indefinite time with a sense of weight or of uneasy sensations in the right hypochondrium or epigastrium. This is followed by pain, intermitting generally, for a variable period not sufficiently marked to call for local examination, but gradually increasing in frequency and intensity. Jaundice then develops, usually gradually, and upon its

occurrence examination is made of the hepatic region. A tumor is generally detected, the presence of which had not been suspected probably, occupying the region of the gall-bladder in health, or found below that region and to the right of the umbilicus. The tumor is usually small and hard, and painful on pressure. With the onset of jaundice, the symptoms of indigestion, which were present from the first, become more aggravated. Loss of flesh and loss of strength are then noted, and with the persistence of the jaundice its usual deleterious secondary phenomena are induced. In the larger majority of cases these symptoms continue with the final termination of the case, and death is caused by exhaustion or by cholæmia, or by intercurrent disease. In quite a number of cases, however, other phenomena may occur in the course of the disease, the symptoms above noted being essential. Thus, in some cases, the fever commences at first about the middle period of the disease and continues to the end, either being intermitting or of continuous character, and always due to the presence of inflammatory complications. Vomiting may be one of the important and persistent symptoms, particularly if there is noted marked increase in the size of the tumor. Constipation, often present throughout the course of the disease, is naturally expected. Diarrhœa attends quite a number of cases, and its onset after an attack of increased pain and local tenderness in the gall-bladder region, associated with fever, is often caused by the occurrence of ulceration between the colon and the gall-bladder. In a few cases ascites is noted and its occurrence as an accidental complication must be remembered. Throughout the course of the disease the liver usually remains about the normal size.

Diagnosis.—The diagnosis of this affection presents the same difficulties that arise in an attempt to recognize any chronic affection of the organs and tissues in the upper central half of the abdominal cavity. Early in the history of the case it is impossible to make a positive diagnosis, while even in its full development the difficulties often are not much lessened. But by attention to the perfect evolution of the disease, as indicated in the symptomatology, coupled with a consideration of its frequent etiological associations, and with exclusion (by the customary means, and by recent methods of clinical research in gastric diseases) of disease of the surrounding viscera, carcinoma of the gall-bladder can be more than strongly surmised.

Not much can be learned from the pardonable errors of writers or

the difficulties that they encountered in their observation of this disease. One can readily appreciate their difficulties, however, and easily understand how the disease can be confounded, as it has been, with cancer of the pylorus, with cancer of the liver, and with an ovarian tumor, when one remembers the extraordinary changes of position and structure which malignant growths of the gall-bladder may undergo. Even in the light of the clinical history with the autopsy, one can scarcely see how anything but the diagnosis of an ovarian tumor could have been made in Case XII. of the Table accompanying. In this instance, the gall-bladder was enormously distended, and adherent to the round ligament, occupying the position which ovarian tumors usually take in the abdominal cavity. In some few instances the tumor was mistaken for a floating kidney; the methods of differential diagnosis we will refer to again.

As aids to the diagnosis, we must first bear in mind the age and sex of the individual, and the prominent relation of gall-stones to this affection. They appear to be more striking factors in carcinoma of the gall-bladder than in carcinoma of any other organ in this neighborhood. Another minor, but important, fact in the differential diagnosis is the short duration of the case—the average duration, between six and seven months, is certainly shorter than in cases of carcinoma of the pancreas and carcinoma of the stomach.

Before attempting a differential diagnosis of the various affections with which this disease may be confounded, let us consider the prominent symptoms of cancer of the gall-bladder, and determine, if possible, if there are any characteristics of them that pertain particularly to this affection. Pain is the first and most prominent of these, but does not differ from pain due to any other disease in this neighborhood, and is especially allied to the pain of carcinoma of other organs; of itself, therefore, save in location, it is not a valuable diagnostic factor. Nor is jaundice of itself of much value. It indicates that there are obstructions in the biliary passages, but of the nature of these its occurrence gives no clew. Emaciation is common to most of the affections of a chronic nature here found, and it, too, is not of any value. The occurrence of fever is only an index of the occrrrence of processes secondary to the malignant growth—processes, too, which may occur secondarily to any obstruction of the biliary passages. In it, likewise, we see no positive value from a diagnostic standpoint. The cachexia,

which is insisted upon by so many authors as presenting a valuable aid to diagnosis, simply indicates, if its presence can be determined, that there is malignant disease, the exact nature of which, however, it does not, of course, determine. Indigestion, loss of appetite, the vomiting that possibly occurs, are likewise of small diagnostic value. The occurrence of the tumor is certainly the only distinctive condition of this affection which may be studied independently or without association with the other symptoms. Singly, therefore, the symptoms just enumerated are of no value whatsoever; but grouped together, observing their association in the proper relationship which we indicated under the symptomatology, they are of value, and only in that way.

A word further, however, regarding malignant tumor of the gall-bladder and tumors with which it is confounded. The size and shape and the position of the former tumor must be borne in mind. It frequently changes in position as adhesions form, and sometimes in shape, as when perforation takes place. Thus, a tumor found early in the right hypochondrium, may later be found in the epigastrium or about the umbilicus. At first smooth and fluctuating, it may diminish in size and become hard and irregular. Usually noted as fixed, it is sometimes quite movable. It may contain bile or calculi, or simply the clear fluid, the accumulation of which is known as hydrops vesicæ felleæ.

If the tumor is believed to be the gall-bladder, one must distinguish between enlargement from an accumulation of its contents, and enlargement of the organ from disease of its walls. The tumor due to the accumulation of fluid occupies a similar position, but is generally much more movable than tumors due to cancerous disease. Their characters have been frequently dwelt upon. They are usually painless, and the nature of the fluid can be determined by the aspirator. Dropsy of the gall-bladder occurs from obstruction of the cystic duct, which may be due to a stone or to the inflammation that follows the passage of a calculus, or to an adherent inflammation which attends some forms of chronic catarrh of the ducts. It may attain a large size, and, indeed, is usually of larger size than in cancer, is painless, and is generally, although not necessarily, associated with the symptoms of obstruction of the hepatic and common ducts. A history either of gall-stones, or

in the writer's experience, more frequently of catarrh of the ducts, antedates the development of the tumor.

The exact nature of a tumor of the gall-bladder can be more definitely ascertained by means of aspiration, and by determining the nature of the fluid contained in the viscus an idea can be formed of the morbid process. The presence of stones can be ascertained, if the gall-bladder is enlarged from that cause, by means of the aspirating needle, too, or by a probe introduced through a canula, as has been previously described by various writers. One must remember, however, that calculi are present in cancer of the gall-bladder in the various relations previously described, and, therefore, the presence of a stone, as detected by a needle, does not necessarily exclude carcinoma. Moreover, one can readily be deceived by this means of exploration, for the hard scirrhous masses very frequently give to the hand the same sensations of hardness, and even the same character of sound, that one gets with stone. The calculi often by palpation move upon themselves, causing a peculiar grating sensation, and even a rubbing sound can be created, and the tumor caused by their accumulation is hard and rough. The enlargement of the gall-bladder due to an accumulation of fluid is usually progressive, and more rapidly increases in size than a carcinoma.

One cannot possibly, from the physical characters of the tumor, determine the nature of the obstruction; for a carcinomatous mass small in size may obstruct the outlets of the flow of bile and cause this tumor formation. A clear fluid would indicate obstruction of the cystic duct, and, other symptoms being latent, such obstruction is in all probability due to inflammation with adhesion of the canal. Tumors containing bile indicate obstruction of the common duct, as by a calculus or by external pressure, the exact nature of which can only be ascertained by the history of the case and by the order of development of the different phenomena. Tumor of the gall-bladder may be due to purulent inflammation with accumulation of pus. The aspirator would reveal the nature of the tumor, while the phenomena of inflammation would contribute to its recognition. Of course, just such condition takes place in cancer of the biliary passages, is frequently an epiphenomenon, and, therefore, the presence of symptoms indicating it are weighed with the previous symptoms indicative of malignant disease of the gall-bladder. Just as in the other conditions indicated, the

nature of a tumor of the gall-bladder cannot be determined without studying also the general symptomatology and etiology in each individual case.

Having considered the characters of tumors of the gall-bladder, other affections which are associated with or are the cause of a tumor in the right hypochondriac or umbilical region must be excluded.

Jaundice from cancer of the pancreas is most common; the differential diagnosis between the two affections is of importance. On the whole, the presence of a tumor of the character of cancer in the region of the gall-bladder or to the right of the median line, would exclude cancer of the pancreas; in both a tumor is possible. In cancer of the gall-bladder its position is somewhat different; it is certainly superficial and is movable with respiration or with the movements of the liver. The tumor of cancer of the pancreas is deep-seated, in the median line more particularly, and fixed absolutely. Cancer of the pancreas is attended with fat in the stools in many instances, and is more frequently associated with ascites than is malignant disease of the gall-bladder. In both affections there is jaundice, emaciation, and cachexia. In both there is abdominal pain, but it is more commonly present in cancer of the gall-bladder. Dyspeptic symptoms appear, however, to be more marked in cancer of the pancreas, and particularly is vomiting of more frequent occurrence.

Cancer of the pylorus presents some symptoms in common with cancer of the gall-bladder. In cancer of the pylorus, however, jaundice is rare, while the tumor is likely to be in a different position, possibly more frequently near the umbilicus than in cancer of the gall-bladder, while it does not attain great size without much more marked gastric phenomena than occur in cancer of the gall-bladder. Pain attends both. In cancer of the pylorus it possibly has a more definite relation to the time of taking food. Usually dilatation of the stomach supervenes upon cancer of the pylorus, while chemical examination of the gastric juice or the matters washed out of the stomach may indicate the presence of cancer of that organ, or at least of organic disease.

Disease of the lymphatic glands in the portal fissure, the symptoms of which simulate cancer of the gall-bladder, may be determined by recognizing disease of these structures in other parts of the body, or of distant disease, as carcinoma or tubercle, which may lead to secondary disease in these glands. The tumor due to disease of the

lymphatic glands, which simulates the enlarged gall-bladder, of course only is of the same character as an enlargement on account of accumulation of fluid. The glands themselves cannot be made out by palpation. We can only suspect their presence, therefore, by the means just indicated. This presumption is made more probable by the absence of pain or of local tenderness. Tumors of the omentum and mesentery rarely, if ever, assume the position that tumors of the gall-bladder occupy. A tumor of the mesentery, for instance, does not occupy as limited an area, but will fill the umbilical region and extend into the epigastric or hypochondriac regions, while tubercular disease of the omentum causes a transverse tumor of the abdomen. They rarely produce jaundice, and are likely to be secondary to processes similar to disease of the lymphatic glands in the fissure. If tubercular, ascites is always present, and the general phenomena of tuberculosis, fever, sweats, etc. Tumors of the omentum, non-tubercular, are usually found in a lower position in the abdominal cavity, and if cancerous are associated with bloody effusions in the abdominal cavity. Cancer of the transverse colon may cause symptoms very much like those of cancer of the gall-bladder. Symptoms due to stenosis of the bowel would arise, however, early in the course of the former disease, while they do not occur in the latter. Then, too, the phenomena of each usually differ.

The enlarged and movable gall-bladder may be taken to be a floating kidney. Landau refers to such a case. Mears has recently had a case of tumor of the gall-bladder which was mistaken for a floating kidney; and once in the writer's experience a large, rather firm, rounded tumor in the gall-bladder region, movable on pressure, and after some prolonged pressure disappearing entirely for hours or even a day, when the patient was kept at rest, was thought to be a floating kidney. The tumor had all the characteristics of a solid tumor, but was due to an extremely distended bladder filled with bile, the duct being obstructed by a small secondary carcinoma. One can conceive considerable difficulty, however, in certain instances in the differential diagnosis, particularly in those cases of floating kidney which are attended with colic. The general condition of the patient, and the evidences of alteration in hepatic structure or function are to be considered.

For practical purposes, cancer of the gall-bladder need not be distin-

guished from *primary cancer* of the *liver*. It can, however, generally be so distinguished by the absence of enlargement of the organ, by the almost constant occurrence of jaundice, by the absence of general hepatic pain, and by the absence of the irregular outline or masses over the surface of the liver. In all probability primary cancer of the liver is of much rarer occurrence than cancer of the gall-bladder and bile-ducts. Ascites occurs more frequently in cancer of the liver than in cancer of the ducts. *Hydatid disease* of the *liver*, with or without rupture into the gall-bladder and ducts, presents no features in common with carcinoma of the gall-bladder. In both, it is true, the disease is chronic, in hydatid disease eminently so; in both there may be jaundice, in hydatid disease less frequently than in cancer; in both there is a tumor, in cancer more localized, smaller in size, and more painful. In cancer, emaciation, cachexia, and loss of strength go hand in hand, while in hydatid disease these conditions are absent. The associated etiological conditions are far different from those of cancer, while exploration with aspirator or trocar shows the presence of an encysted fluid which has the characters of a hydatid cyst. Hydatid disease of the gall-bladder or of the gall-ducts is usually accompanied by jaundice, by attacks resembling biliary colic, and is frequently associated with fever and with diarrhœa. After an attack of colic in hydatid disease the tumor lessens because of communication with the biliary passages, and the discharge of its contents into the intestinal canal. In cancer, the tumor lessens after a period of pain and fever similar to a local peritonitis. In hydatid disease the tumor usually returns; in carcinoma when it disappears it never returns.

In that peculiar disease known as multilocular hydatid disease there are symptoms very like the disease we are studying. There is found a hard nodulated tumor with intense and persistent jaundice, rapid emaciation and prostration, and ascites. The tumor of a multilocular hydatid does not occupy the region of the gall-bladder usually, but has the other characteristics of cancer. In almost all cases, however, this form of hydatid disease is associated with enlargement of the spleen, a condition always absent in primary cancer of the biliary passages. Of course, in this disease the age and sex and the evolution of the disease must be remembered.

The occurrence of fever, associated with a tumor or swelling in cancer of the biliary passages, might lead one to suspect the presence of ab-

scess of the liver. The absence, however, of jaundice in abscess of the liver, its rarity in this climate—except after ulceration in some portion of the portal area, which can frequently be determined—the enlargement of the liver, the different character of tumor, its increase in size, the entire disease progressing more rapidly, are points in favor of abscess of the liver.

DURATION AND COURSE.—The duration of carcinoma of the gall-bladder appears to be about six and two-thirds months. The shortest case was seven weeks, the longest alleged to be four years. It was not included in making up the average.

The course of the disease is uniformly and progressively downward, generally; in some its course is intermitting. The symptoms abate for awhile. The progress is modified by complications. Jaundice hastens the end, while the accidental occurrence of peritonitis is always fatal. In two instances death took place from perforation of the bladder into the peritoneal cavity, and in ten instances from peritonitis, and in two from perforation into neighboring organs. Cholæmia was the cause of death in eight instances, exhaustion in twenty-four, marasmus in two. Shock, dysentery, œdema of the lungs, acute pleurisy, and asthma complicated the affection, and were the immediate cause of death once each.

CONCLUSIONS.—1. Primary cancer of the gall-bladder is not as rare a disease as we have been led to believe.

2. It occurs in females nearly three times as often as in males.

3. The larger number of cases occur before sixty. It is not a disease of as late life as has formerly been taught.

4. Gall-stones are a possible exciting cause, especially in a person predisposed to carcinoma.

5. The organ is not generally much enlarged, save occasionally by the secondary process of dilatation.

6. Metastasis is not widespread, and by continuity of structure neighboring organs are involved.

7. Adhesion to adjacent organs, and ulceration and perforation are not common.

8. Pain, jaundice, emaciation, cachexia, and tumor are present in the largest number of cases; while indigestion, vomiting, constipation or diarrhœa, and ascites are of more frequent occurrence than most

persons think, and are important associate phenomena by means of which the disease is recognized.

9. Pain occurs in about 62 per cent. of the cases; at first ill-defined, it soon becomes localized to the right hypochondrium, and is lancinating in character.

10. Jaundice in about 69 per cent. of the cases; it gradually increases in intensity.

11. Tumor in about 68 per cent. of the cases.

a. Situated in:

1. The gall-bladder region.
2. To the right of the umbilicus.

When it is in the latter location the liver is usually enlarged.

b. Character:

1. Hard or firm.
2. Painful and tender.

12. The progress of the disease is almost always progressive, and toward a fatal termination.

13. Complications are due to:

1. Occlusion of the ducts and secondary effects on the liver and gall-bladder.
2. Ulceration and perforation of gall-bladder.
3. The symptoms that arise by metastasis in other organs.

14. Duration is short, the average being six and two-thirds months.

15. Death due to:

1. Exhaustion.
2. Peritonitis.
3. Metastasis to other organs.
4. Biliary obstruction.

PART II. PRIMARY CANCER OF THE BILE-DUCTS.

Eighteen cases of carcinoma of the biliary passages confined to the ducts have been collected. In the series an actual history of hepatic colic was present in two, and in three a problematical one.

AGE.—The average age of fifteen cases was 56.3-5 years. In three cases the age was not given. The oldest was 81; the youngest 35. Four occurred between 44 and 50, three between 51 and 58, three between 62 and 68, two between 72 and 74.

SEX.—There were 9 males and 9 females.

SYMPTOMS.—*Pain* was noted present in twelve cases, the duration of which continued, in individual cases, from one month to two or three years. In one case the patient was said to have had epigastric pain extending to the shoulder for ten years. Pain is one of the earliest symptoms observed. It is usually located in the epigastric region (six cases). In five the pain was present in the hepatic region or the right hypochondrium, and was either spontaneous or developed by pressure. The character of the pain varied. In one it was described as bilious colic; in another as cramp-like in the stomach; generally the pain occurred in paroxysms. It varied in intensity. In some only slight sensitiveness on deep percussion could be elicited. In one instance the pain varied at different periods of the disease (see Musser's case). Usually, however, while the most persistent, and the most frequent of all symptoms, it never created much disturbance. Of the five cases Dr. Delafield described, two had attacks of severe epigastric pain, the onset being accompanied with jaundice, and one had pain throughout the course of the disease. Paroxysmal pain, occurring particularly about the time of the development of jaundice, appears to be the most common symptom of this affection.

Jaundice is the most frequent symptom (seventeen times). In most instances its duration practically indicated the duration of the disease. The duration in twelve cases occupied the following number of months: 5, 6, 4, 5, 24, 6, 3, 15, 7, 3, 2½, 18, 24, and 36 months. It usually deepened in intensity, and in four instances it was attended by itching. It terminated in coma in two cases, and delirium in three. In eleven instances in which the stools were described, ten presented the characters usual in jaundice, and one was black from blood. In Delafield's cases the jaundice developed rapidly, and progressed throughout the course of the disease, and it was the first symptom in all the cases. In three of his series the usual hemorrhages that attend chronic jaundice were present.

Tumor.—The statement of the occurrence of a tumor was made in 8 of the cases, and the position described to be as follows: in the right hypochondrium, in the region of the pylorus, in the right iliac region, opposite the umbilicus, in the right nipple line, and in the remaining instances in the gall-bladder region. It was described as hard, rounded, painless, twice, and three times it was stated to have the characteristics of an enlarged gall-bladder. In one it was first

found to be as large as a pigeon's egg, and then grew to that of a hen's egg, and was painful; in another it slowly increased in size while under observation. In two instances the tumor was only described as painful. In Delafield's cases a tumor could not be detected during life, and the autopsies showed that the infiltration of the bile-duct was not sufficiently large in any case to have been detected before death.

The liver was noted to be enlarged in eight cases, with pain and tenderness on pressure. In four the liver was not enlarged and its edge not felt. In three cases the surface and edges of the liver were particularly described as free from any nodulation.

Gastro-intestinal symptoms were marked in all the cases, as follows: Loss of appetite occurred in five of the cases; marked dyspeptic symptoms in four; vomiting in nine; nausea without vomiting in two; diarrhœa in two, and constipation in the same number. Hemorrhages from the gastro-intestinal tract were noted in two instances. As associated phenomena, in one case each, the following gastro-intestinal symptoms were noted; catarrh, bloody stools (due to jaundice probably), choleraic attack, and the symptoms of strangulation of the bowel. In two cases the abdomen was found to be much distended. The gastro-intestinal symptoms were the most marked in all of Delafield's cases, loss of appetite, nausea and vomiting occurring in each. In one instance hemorrhages took place from the stomach, but the three symptoms indicated, jaundice, pain, and particularly vomiting, are the most prominent symptoms of this affection. In seven of the recorded cases fever was present some time throughout the course of the disease; in four it was intermittent; in one irregular, "associated with phthisis"; in two the characters were not described, in one of which, at least, there was an intermitting form of fever, as it was described as occurring in the evening only. In the five cases of Delafield, febrile movement was noted in one only, and in that it was probably due to suppurative inflammation of the bile-ducts.

PATHOLOGICAL ANATOMY.—In fourteen instances the common duct was involved in the disease—once with the cystic duct; in three instances the hepatic duct, and in one the hepatic and cystic together. In three of these cases the growth was seated at the duodenal orifice. The bile-ducts were dilated in nine cases. In brief detail the pathological anatomy of each case was as follows:

1. Common bile-duct distended and obstructed by medullary cancer growing from internal surface. Bile-ducts dilated.

2. Common bile-duct has encephaloid cancer near spur formed by union of cystic and hepatic ducts. Obstruction of canal.

3. Common bile-duct closed by a tumor. Bile-ducts dilated.

3. Common bile-duct at duodenal orifice obstructed by a cherry-sized tumor. Cylindrical carcinoma (?).

5. Common bile-duct at beginning has walnut-sized tumor surrounding portal vein and hepatic artery. Bile-ducts dilated.

6. Common bile-duct at duodenal orifice is surrounded by an irregular fungous growth. Bile-ducts dilated.

7. Hepatic duct and common duct thickened, firm walls, uniform yellow-gray. Common bile-duct collapsed but unaltered.

8 and 9. Common bile-duct carcinoma.

10. Dense whitish mass, no secondary deposits, occluded common and cystic ducts. Bile-ducts dilated.

11. Common bile-duct blocked by a soft, whitish, sprouting encephaloid cancer just below junction of cystic and hepatic ducts. Duct above enormously dilated.

12. Hepatic duct constricted by a cancerous growth. Ducts greatly dilated.

13. Common bile-duct entirely replaced by a soft whitish growth. Hepatic duct dilated. Bile-ducts enveloped by cancerous matter.

14. Common bile-duct has cancer at duodenal orifice, size small nut—a softened scirrhus. Bile-ducts enormously dilated.

15. Common bile-duct has, near junction of cystic and hepatic ducts, a cherry-sized tumor; walls infiltrated and contracted. Another hard tumor in track of hepatic duct.

16. Primary cancer bile-ducts with constriction of hepatic duct by scirrhous infiltration. Bile-ducts considerably dilated.

17. Scirrhus of hepatic and common ducts. Bile-ducts dilated.

18. Common bile-duct primary carcinoma, walls thickened, lumen occluded, secondary nodules in liver and head of pancreas. Cystic duct closed by cancerous mass.

Delafield states that in two of his cases the walls of the duct were the seat of cancerous infiltration alone; in two the new growth had extended to that portion of the pancreas immediately beneath the bile-duct, infiltrating its tissue to a moderate extent. In all the new

growth seemed to have originated in the mucous glands in the walls of the duct and had the characters of an epithelial cancer with cells of the cylindrical variety. In one of the cases there was catarrhal inflammation of the bile-ducts with suppurative inflammation of the adjacent liver tissue, producing small abscesses.

Gall-bladder.—The gall-bladder was dilated and distended in eight cases, and contained calculi in seven. It was atrophied in one; occluded in one; and adherent to the pancreas in one, and the seat of some suppurative inflammation in two. Delafield found dilatation of the gall-bladder in only one of his cases.

Liver.—Gall-stones were found to be present in four cases. The organ was enlarged in eight of the cases and the seat of secondary deposits in seven. This enlargement was most common in Delafield's cases (four out of the five). The changes in the ducts have been mentioned.

Metastasis.—As just indicated, in seven instances secondary growths were found in the liver, in one each in the mesenteric glands, the peritoneum, and the pancreas. It is worthy of note that metastasis to distant organs does not take place save rarely. In the combined lists of cases, in one only were secondary growths found outside of the abdomen. In this instance, a case of Delafield's, the growth was found in the lungs.

THE CAUSE OF DEATH.—Death usually takes place from exhaustion, one-half of the cases being thus recorded. Jaundice, as previously noted, was of course the cause of the fatal termination in two cases by coma, and the effects of the jaundice, namely hemorrhages, caused death in one. Accidental complications, as pneumonia, pericarditis, œdema of the lungs, and ascites were noted to be the cause of death in four of the cases.

THE SYMPTOMS of primary cancer of the gall-ducts are the symptoms of obstructive jaundice. It is seen that jaundice is the symptom common to all. Vomiting is next in the order of frequency. Pain, a tumor containing bile, and gastro-intestinal symptoms occur in all forms of obstructive jaundice and are not significant. No general symptoms arise to lead one to suspect the presence of a malignant tumor, or they are masked by the jaundice.

Hence it is difficult, in fact well-nigh impossible, to recognize the disease. By exclusion, obstructive jaundice due to external pressure may be eliminated. But jaundice, after a cicatrix in the bile passage,

or in cases of adhesive inflammation, has common symptoms. Practically, jaundice due to calculi is the most important form to recognize. Attention to the previous history and to the mode of onset of the disease is important, as well as attention to the well-known phenomena of impacted gall-stone.

CONCLUSIONS.—The conclusions regarding the disease are more striking when compared with similar conclusions from cases of cancer of the gall-bladder.

1. Carcinoma of the bile-ducts is less frequent than cancer of the gall-bladder.

2. Unlike cancer of the gall-bladder it occurs equally in both sexes.

3. The age of both is about the same.

4. Gall-stones are less frequent when the ducts are the seat of the disease.

5. The gall-bladder is not much enlarged and only by dilatation.

6. Metastasis is not common and not distant.

7. Adhesions and ulceration and perforation do not occur.

8. Jaundice, vomiting, pain, and gastro-intestinal symptoms are the most common.

9. Jaundice is more frequent in the second than in the first series of cases.

10. The last symptom mentioned contributes largely to a cause of the short duration of the disease.

11. The sequelæ of jaundice and accidental or intercurrent diseases are the cause of death.

12. A tumor is present in a smaller ratio of cases than when the gall-bladder is the seat of disease. It is never as large as in cancer of the gall-bladder.

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Delafield, N. Y. Med. Journ., May 26, 1883, p. 582.

APPENDIX.

Abstracts of Cases of Primary Cancer of the Gall-bladder.[1]

Case I.—Female, age seventy-two. Encephaloid. Colic and diarrhœa; after a fall a painful tumor in flank; pains in right hypochondrium; slight jaundice. Course indefinite. Duration two months. Shock and debility. Gall-bladder large, hard, rough. An encephaloid mass adherent inside. Twenty calculi. Durand-Fardel, *Archiv Gén. de Méd.*, Paris, 1840.

Case II.—Female, age seventy-one. Encephaloid. Slight jaundice. Round, indolent, slightly movable tumor at lower border of liver in the region of the gall-bladder. Course latent. Death from acute pleurisy. Encephaloid growth at the fundus of the gall-bladder. Small black calculi in gall-bladder, which was of the size of a hen's egg. First case quoted by Villard (op. cit.). Duthier and Notta, *Bull. Soc. Anat.*, Paris, 1847, xxii. 335.

Case III.—Female, age sixty-one. Encephaloid. Darting and wandering pains; sensations in right hypochondrium; anorexia; emaciation; vomiting; constipation; jaundice one month. Painful smooth tumor sixth rib to crest of ilium. Pulmonary symptoms. Œdema of feet. Several months' duration. Death from marasmus. Liver olive-green; numerous secondary nodules; ducts dilated. Walls of gall-bladder thickened. Cavity containing dark liquid and fungous growth. Walls ulcerated. Cystic duct involved; canal obliterated. Second case of Villard. Icery, *Bull. Soc. Anat.*, Paris, 1853, xxviii. 73.

Case IV.—Female, age seventy-four. Encephaloid. Pain in right hypochondrium; slight jaundice; liver enlarged three fingers below short ribs. Tumor in cæcal region of great mobility. Duration less than one year. Debility. Liver filled with secondary nodules size of walnut. Walls of gall-bladder thickened and involved in the disease. Formed by fungoid growth which constituted tumor in life. Mobile; two calculi in gall-bladder. Obstruction by pressure of a lymphatic on duct. All the ducts pervious. In the discussion MM. Lebert, Durand-Fardel, and Maillot thought that calculi cause carcinoma, and Deville, Broca, and Demarquay opposed this view. Rippoll, *Ibid.*, 1849, xxiv. 359.

Case V.—Female, age thirty. Encephaloid. Tumor hard, round, irregular, slightly movable in right hypochondrium. Jaundice two months. Vomiting greenish fluid. Diarrhœa after constipation. Œdema of legs. Emaciation; debility. Duration indefinite. Under observation three months. Death from debility. Gall-bladder infiltrated; cavity reduced to pouch 0.5 inch long, containing gall-stone. Inner surface ulcerated. Adherent to duodenum with perforation. Secondary deposits in liver. Ducts dilated; cystic, cancerous; hepatic and common normal. Paulicki raises the question of relation of carcinoma to gall-stones. Paulicki, *Berlin. klin. Wochenschrift*, 1867, p. 348.

Case VI.—Female, age forty-eight. Encephaloid. Pain in abdomen and right hypochondrium. Tumor elevated, fixed, not knotty, attached to the liver. Rigors, fever at first, jaundice second; ascites, œdema; œdema of feet; albuminous urine. Vomiting occasional; constipation. Duration two and a half years. Death from peritonitis. Œdema of lungs; acute peritonitis. Bile-ducts in left lobe dilated; few in right. Gall-bladder the size of an apple; adherent to colon and communicating. Fibrous and soft semi-liquid red-gray textures and twenty stones in bladder; one in intestine. Coraza, *Schmidt's Jahrbücher*, 1873, Bd. 160.

Case VII.—Female, age forty-nine. Encephaloid. Increasing debility; pain violent and acute; tenderness in right hypochondrium. Bilious vomiting; jaundice; constipation; anorexia; rigors; fever; coma. Duration eight months. Death from cholæmia. Liver hypertrophied and infiltrated with bile. Gall-bladder destroyed and replaced by encephaloid growth which invaded cystic, hepatic, and common ducts and adjacent liver, pancreas, stomach, and duodenum; latter perforated. Henrot and Chatelin, *Bull. Soc. Méd. de Rheims*, 1874, xiii. p. 22.

Case VIII.—Female, age thirty-eight. Encephaloid. Emaciation; pain in lumbar region and end of right floating ribs. Tender in these locations. Vomiting; jaundice; liver normal; fever one month. Duration three months. Death from exhaustion. Liver green color; ducts dilated, secondary masses. Gall-bladder replaced by a tumor adherent to duodenum and communicating; in centre of which a cystic pouch containing mucus and calculi, adherent to vertebral column, turning vena cava out of course. Lymphatic involvement: common duct destroyed. Remy, *Bull. Soc. Anat.*, Paris, 1875.

Case IX.—Female, age thirty-four. Encephaloid. Emaciation; pain in hepatic region and tenderness; weakness; pallor; some fever; at first severe diarrhœa and vomiting. Smooth

[1] In the arrangement of the abstracted cases, the following order is observed when the appropriate facts are indicated in the original: sex and age, character of carcinoma, symptoms, duration, and cause of death, record of autopsy, reporter and reference. The cases had been arranged in tables and when changed to this form the headings of the columns were omitted.

tumor in right hypochondrium; liver enlarged. Duration four months. Death from exhaustion. Gall-bladder enclosed in an encephaloid growth; atrophied; reduced to a cylindrical canal the size of a little finger; ducts normal; liver enlarged; secondary deposits. Cowy, *Bull. Soc. Anat.*, Paris, 1878.

CASE X.—Male, age fifty-six. Encephaloid. Emaciation; jaundice; hepatic pains; vomiting and purging. Liver enlarged; tumor painful, immovable, in region of gall-bladder connected with liver; ascites; œdema; color of feces restored before death. Duration three months. Death from exhaustion. Liver enlarged; secondary nodules; gall-bladder destroyed by cancerous ulceration; communication of resulting cavity with transverse colon. Murchison, *Dis. of Liver*, second edition, 1877.

CASE XI.—Female, age forty-nine. Cylindrical carcinoma. Three years before, while in good health, suddenly had cramp-like pain in gall-bladder region, which was frequently repeated. Painful swelling in right hypogastrium, redness of skin, perforation. Over one hundred gall-stones evacuated. After persisting a year opening closed, but soon two new ones opened and discharged stones. Repeated colicky pains. Latterly pain changed in character, and became more continuous, dull, and boring in character; then epigastric pain and vomiting, jaundice, etc., stools white and dry. On admission a carcinomatous ulcerated surface upon the skin, and beneath a lumpy tumor in gall-bladder region; cachexia. Contracted carcinomatous gall-bladder containing a gall-stone the size of a cherry-stone. Secondary carcinomata of pylorus, abdominal walls, and inguinal glands; dilated stomach; ductus choledochus occluded but not obliterated; epithelial biliary fistula. Quetsch, *Berlin. klin. Woch.*, 1885, xxii. 672.

CASE XII.—Female, age fifty-eight. Encephaloid. Tumor fourteen years in right inguinal region; pains in back, right side, and epigastrium. Liver dulness continuous with tumor in right lower side of abdominal cavity; immovable; fluctuating. Emaciation; jaundice; itchiness; anorexia; constipation; fever. Tumor seemed attached to uterus by pedicle; irregular in outline and tuberous, soft, crackling on palpation; sudden diminution in size, but mass in right hypochondrium again enlarged. Duration actually seven months. Death from exhaustion. Diagnosis before death—ovarian tumor. Cancer of neck of gall-bladder, and lymphatic glands in portal fissure. Hepatic ducts compressed; secondary deposits in liver; enormous distention of gall-bladder and hemorrhage into it: adhesions to colon and round ligament; gall-stones. Osler and Bell, *Canada Med. and Surg. Journ.*, April, 1877; *Path. Rep. Mont. Hosp.*, 1877.

CASE XIII.—Female, age sixty. Encephaloid. Pains in right hypochondrium; jaundice indigestion; ascites; œdema. Liver not enlarged; surface irregular. Peritonitis. Emaciation; cachexia. No previous biliary colic. Duration three months. Death from peritonitis. Diagnosis before death—cancer of the liver. Gall-bladder replaced by a pouch the size of a turkey's egg; adherent to colon with perforated walls containing pus and gall-stones. Cystic duct closed; others permeable. Secondary deposits in liver and mesentery. Leroux, *Prog. Méd.*, 1880, viii.

CASE XIV.—Age sixty-three. Encephaloid. No history. Gall-bladder size of a man's fist; thickened; composed of two pouches, one containing calculi, the other carcinomatous partially liquefied masses. Chiari, *Bericht der K. K. Krankenanstalt*, Wien, 1879, p. 484.

CASE XV.—Female, age fifty-nine. Encephaloid. Increasing abdominal swelling for five years; troublesome only for two months. Gall-bladder infiltrated and surrounded by a mass of medullary carcinoma. Cystic duct obliterated; gall-stones. Duodenum compressed and walls infiltrated. Lumbar glands and liver by contiguity only secondarily affected. Stomach dilated. Peritoneum and pleura affected. Moore, *Trans. Path. Soc.*, London, 1880, xxxi. p. 138.

CASE XVI.—Female, age thirty-seven. Encephaloid. Long-continued intermitting fever; epigastric and hepatic pains; jaundice; liver and spleen enlarged; emaciation; nausea; vomiting green-yellow fluid; constipation; exhaustion; no tumor. Death from exhaustion. Liver normal size; ducts dilated and seat of purulent inflammation. Gall-bladder normal size; the cystic end involved in disease; wall three-quarters of an inch thick; gall-stones; no obstruction in common duct. Musser, *Trans. Path. Soc. Philada.*, 1881.

CASE XVII.—Female, age seventy-eight. Encephaloid. Symptoms of internal strangulation. Death from ulceration and perforation of gall-bladder. Gall-bladder cancerous, adherent to duodenum and colon and communicating; gall-stones in gall-bladder and in ulcer. Cruveilhier, *Anatomie Pathologic.*, 1852, ii. 547.

CASE XVIII.—Female, age seventy-two. Encephaloid. Jaundice; intermitting fever; tumor; liver enlarged; vomiting; hemorrhages. Walls of gall-bladder thickened, cancerous, adherent to duodenum, containing pus, gall-stones, and cancer débris with gall-stones in it. Charcot, *Obs.* XVI., of Villard; *Cancer primitif des voies biliares.*

CASE XIX.—Female, age fifty-six. Encephaloid. Emaciation; weight in abdomen on exertion for two or three years. Tumor in right hypochondrium opposite navel the size of a goose's egg; movable; hard; tender; rapid growth. Pain increased by any movement; peculiar ptyalism. Gall-bladder adherent to duodenum; posterior wall very thick, firm, but not hard; light yellow. In contracted cavity ninety-nine friable gall-stones and a creamy fluid. Cystic and pancreatic ducts obliterated. Pancreas, liver, and duodenum secondarily diseased. Stokes and Foote, *Dublin Quart. Journ. of Med. Sci.*, 1865, xxxix. p. 218.

CASE XX.—Female, age seventy-five. Scirrhus. Vomiting red liquid; nausea; no jaundice. Liver large; outline regular. Tumor in epigastrium. Adynamia from catarrhal pneumonia. Course like gastric cancer. Liver healthy; epigastric tumor a mass in left lobe of liver. Gall-bladder made of pouches adherent to colon; tumor in it; grumous fluid and gall-stones. No cystic canal. Hepatic duct had bile. Durand-Fardel, *Archiv. Gén. de Méd.*, Paris, 1840.

CASE XXI.—Female, age seventy-six. Scirrhus. Pain dull and also lancinating; increased by pressure. Tumor size of a chicken's egg in right iliac fossa; hard; irregular; continuous with liver; immovable; jaundice. Duration four months. Death from peritonitis and marasmus. Tumor size of two eggs, formed by gall-bladder, a smooth, hard surface; irregular,

immovable. Contents thick gray fluid and twenty calculi. Cystic duct narrowed; hepatic and ductus choledochus normal; secondary deposits in liver near gall-bladder. Early in the case the tumor felt on certain motion and by pressure only. Durand-Fardel, *Ibid.* Case IV. of Villard.

CASE XXII.—Female, age sixty. Entered hospital August 27, 1879, for pronounced icterus, digestive troubles, and cachexia. Had been sick only two months; pain in right hypochondrium, local for one month, and then extended to whole belly, which swelled. Three weeks ago (August 1st?) jaundice; later œdema of limbs, digestive troubles, great emaciation. Liver enlarged, surface uneven, great ascites. Death September 14th. Duration two and a half months. Scirrhus of walls of gall-bladder; calculi; secondary deposits in liver. No alterations in stomach, duodenum, or colon. Cystic duct impermeable. Cancerous infiltration of omentum. Purulent and fatty matter in common duct. Scirrhus. H. Leroux, *Progrès Méd.*, 1880, viii. 390.

CASE XXIII.—Female, age fifty-eight. Scirrhus. Emaciation; ascites; jaundice. Pain all over abdomen then in right hypochondrium and epigastrium. Tumor; constipation. Death from exhaustion. Gall-bladder normal size; walls infiltrated; contained liquid like serum and gall-stones. No trace of bile. Ductus choledochus obliterated; hepatic ducts dilated. Case XI. of Villard. Corvisart and Broca, *Bull. Soc. Anat.*, 1848.

CASE XXIV.—Female, age sixty-nine. Scirrhus. Exhaustion; jaundice; vomiting; diarrhœa; hemorrhages, intestinal chiefly. Pain in right hypochondrium; delirium. Duration three months. Death from cholæmia. Walls of gall-bladder thickened and indurated, white-colored; scirrhous; gall-stones and mucus in gall-bladder. Mahieux, *Ibid.*, 1853, xxviii. 180.

CASE XXV.—Female, age fifty. Scirrhus. Cachexia; emaciation; vomiting; constipation; pain in epigastrium. Tumor immovable, indurated; tender; midway between ribs and umbilicus. Duration nine months. Death from exhaustion. Gall-bladder converted into a mass 4 inches long and 1.5 inch thick; mucus in contracted cavity; liver normal; pancreas indurated. Pepper, *Amer. Journ. Med. Sci.*, 1857, p. 18.

CASE XXVI.—Male, age sixty-five. Scirrhus. Fourteen days before death abdomen swollen and painful; peritonitis. Pain in right hypochondrium, paroxysmal; vomiting; delirium. Peritonitis. Death from exhaustion. Gall-bladder replaced by an elongated oval body rough and uneven, in cavity of which gall-stones. Enlarged spleen; liver small; intestines slightly affected. Wagner, *Archiv der Heilkunde*, Leipzig, 1863.

CASE XXVII.—Female, age twenty-eight. Scirrhus. Pain one-quarter hour before taking food. Vomiting of blood. Tumor hard, near pylorus. Jaundice six weeks. Diagnosis—cancer of pylorus. Duration four months. Gall-bladder size and shape of a pear; hard; cavity contracted on eight gall-stones; adherent to duodenum; stomach dilated. Case XVII. of Villard. Markham, *Trans. Path. Soc. London*, 1857, viii. p. 243.

CASE XXVIII.—Female. Scirrhus. Cachexia; anæmia; jaundice, not in conjunctiva, lancinating pain in right hypochondrium; constipation. Tumor in region of gall-bladder, size of a fist, attached to the liver. Gall-bladder contained mucus and 167 calculi; walls of gall-bladder and cystic duct thickened and indurated; bile-ducts and ductus choledochus contained gall-stones; liver cystic and secondary deposits in epiploon. Case IV. of Villard. Prompt, *Bull. de Soc. Anat.*, 1866, xi. pp. 374–5.

CASE XXIX.—Female, age fifty-three. Cylindrical epithelioma. Admitted March 16, 1886. Past two months began with pain in the stomach, lost appetite, and emaciated; skin dry; no jaundice; cachectic, emaciation; no vomiting, but nausea, anorexia, constipation. Stomach uniformly enlarged and sensitive; pain most intense at and under umbilicus. Liver enlarged and tumors; one felt in right flank, painful, hard; one felt under umbilicus. Rapid increase of cachexia; sudden death. Duration two and a half months. March 29th: Liver, weight 2 kilogrammes 750 grammes; encephaloid tumor in right lobe corresponding to gall-bladder; numerous smaller ones throughout liver. Gall-bladder enormously distended; calculi at origin of cystic duct; calculi in cavity; cylindrical-celled epithelioma. Blocq, *Prog. Méd.*, 1886, 25, iv. p. 638.

CASE XXX.—Female, age sixty-five. Cylindrical epithelioma. Emaciation; epigastric and renal pains; vomiting; constipation and diarrhœa; jaundice. Tumor in right hypochondrium, painful, hard, irregular movable; attached to liver; pulmonary symptoms. Duration seven and a half months. Lower portion of gall-bladder adherent to liver and the seat of encephaloid; contiguous portion of liver affected, but other parts free; gall-stones; tight-lacing liver. Mulot, *Bull. Soc. Anat.*, 1882, vii. p. 171.

CASE XXXI.—Female, age fifty-six. Cylindrical epithelioma. Anorexia; vomiting occasional, then persistent; pain in epigastrium, then in right hypochondrium constant; emaciation; anæmia. Tumor rounded, firm, tender; attached to liver; delirium. Duration nine months. Death from exhaustion. Site of gall-bladder occupied by a mass the size of a cocoanut, with a cyst on the surface containing calculi and mucoid fluid. Liver and peritoneum affected by contiguity; no other deposits. Coupland, *Trans. London Path. Soc.*, 1880, xxxi.

CASE XXXII.—Male, age sixty-three. Cylindrical epithelioma. Intermitting fever at the beginning and latter two months; anorexia; constipation; enlarged and tender liver; jaundice; emaciation; enlarged veins over liver. Intermitting pain at first. Duration fifteen weeks. Death from debility. Extremity of gall-bladder and neighboring tissues cancerous; gall-bladder contained green watery fluid and gall-stones. Hepatic ducts dilated; abscesses in their walls; two secondary masses in right lobe. Heart, lungs, spleen, and kidneys normal. Salisbury, *Chicago Med. Journ. and Exam.*, 1879, xxxix.

CASE XXXIII.—Female, age forty-two. Cylindrical epithelioma. Cachexia; anorexia; vomiting; diarrhœa; then constipation; jaundice; ascites. Nodular tumor to right of navel, later fluctuating; atrophied liver; tumor softened. Coma; Bright's disease. Duration thirteen weeks. Cause of death cholæmia. Gall-bladder dilated and filled with mucoid fluid; gall-

stones. Toward cystic duct malignant infiltration ulcerated inside; cystic duct not found. Lumen of common duct obliterated by pressure of glands. Kraus, *vide infra*, No. 61; *Deutsches Archiv für klin. Med.*, Leipzig, 1883.

CASE XXXIV.—Female, age forty-seven. Cylindrical epithelioma. Pain first right side of abdomen; then right hypochondrium and right shoulder. Cachexia, abdominal swelling, and three tumors: first, region of navel; second, to right and above; third, region of gall-bladder; solid, firm, attached to liver; vomiting; constipation; jaundice; coma. Duration seven months. Cause of death cholæmia. Liver double size; brown-red and parts green; several nodules; gall-bladder size of a goose's egg, filled with gall-stones and thin fluid; ductus choledochus dilated and filled with stones and fluid; at fundus of gall-bladder tumor size of an apple, ulcerated inside. Kraus, *Ibid.*

CASE XXXV.—Male, age thirty-five. Cylindrical epithelioma. Began Christmas, 1887, with great pain in stomach and liver regions, shooting to back, and soon associated with meteorism and constipation. Admitted March 1st: Emaciation, icterus, no œdema, but cachexia. Digestive disturbances. No tumor demonstrated, but palpation of stomach and liver regions painful. Constipation, hard brown stools, acid eructations, hiccough. Death March 4. Duration two and half months. Flat ulcer on vocal bands; communication between colon and common duct; gall-bladder adherent to right lobe of liver and much shrunken; walls ½ cm. thick, dense, ulcerated over inner surface; gall-bladder goose-egg size, plaster-like contents; dense cancerous tissue in ring-shape encircling the cavity of the gall-bladder; numerous secondary abscesses in liver. Philipp, *Inaug. Diss.*, Greifswald, 1888.

CASE XXXVI.—Female, age fifty-two. Cylindrical epithelioma. Sudden onset, icterus first two and a half months. Pain in right side: then both hypochondria; and, finally, in right hypochondrium; urine tinged. Liver not enlarged—irregular. Tumor in right hypochondrium, hard and tender; aspirated three times, fifteen quarts removed. Emaciation, ascites. Duration five months. Death with cancerous cachexia, pallor, emaciation, pain, apyrexia. Gall-bladder distended, forming a soft, whitish, pulpy mass, containing several irregular cholesterine calculi. Gall-duct free; secondary epithelioma of liver and peritoneum with cysts. Kidneys slightly atrophied. Heart and lungs normal; spleen small; ascites. Lermoyez, *Le Progrès Médical*, 1884, p. 1095.

CASE XXXVII.—Female, age seventy-two. Colloid. Bilious vomiting and diarrhœa over one year; jaundice one month. Tumor irregular, under border of ribs: size of an hen's egg; pains in right hypochondrium. Jaundice rapidly developed; tumor. Diagnosis—hepatic cancer. Duration one year. Death from marasmus. Gall-bladder a rough, firm tumor, size of a child's fist, filled with colloid cancer, adherent to colon and communicating; no cystic duct; calculus in gall-bladder. Liver normal; ducts dilated. Durand-Fardel, *Op. cit.*

CASE XXXVIII.—Female, age sixty-three. Colloid. Jaundice rapidly developed. Tumor. Gall-bladder carcinomatous and adherent to colon, which is similarly affected. Fistula between colon and gall-bladder. Cruveilhier, *Op. cit.*, p. 543.

CASE XXXIX.—Female, age sixty-six. Colloid. Emaciation; jaundice; anorexia; hiccough; nausea; scanty and ashen dejecta; pain in right hypochondrium, intermitting, then constant. Rapidly growing tender tumor in right hypochondrium. Slight fever. Duration about three months. Gall-bladder as large as a man's hand, rigid, nodulated, thickened walls; interior gelatiniform cancer, gall-stones; light yellow, velvety vegetations; bile-ducts "in their totality" similarly affected; other viscera normal. No hereditary disease. Case VI. of Villard. Villard and Bourneville, *Bull. Soc. Anat.*, Paris, 1869.

CASE XL.—Female, age sixty-eight. Colloid. For six weeks anorexia; constipation; pain. Irregular nodulated tumor, tender, at lower border of liver; abdominal distention; jaundice. Duration one year. Gall-bladder enlarged; walls thickened; contents mucous fluid and gall-stones; part of mucous membrane healthy; ducts obstructed; colloid masses over surface of liver. A few deposits in lungs and kidneys. Cornil and Charcot, *Mém. de l'Acad. de Méd.*, t. xxvii. p. 349.

CASE XLI.—Female, age sixty-six. Colloid. Seat in gall-bladder and bile-ducts. Personelle, Villard's Table.

CASE XLII.—Female, age sixty-two. Villous. No clinical history. Gall-bladder enlarged five inches, pear-shaped; walls infiltrated; cauliflower excrescences, white or vascular; gall-stones, one in ductus choledochus, obstructing it; ducts dilated. Heschl remarks that he has observed two other cases of villous cancer of the gall-bladder with gall-stones during the year. Heschl. *Zeitschrift der K. K. Gesellschaft der Aerzt zu Wien*, 1852, p. 251.

CASE XLIII.—Male. Encephaloid. Jaundice, which disappeared; emaciation; vomiting. Tumor, size of a child's head, in umbilical region to right of median line, soft, then hard. Liver enlarged. Symptoms followed a fall. Gall-bladder enlarged, communicating with colon, and fecal peritoneal abscess; villous excrescences from inner surface of gall-bladder. Secondary deposits in liver. Moxon, *Trans. Path. Soc.*, London, 1867.

CASE XLIV.—Male, age four. Villous. After a fall, one year previous, abdomen began to swell. Vomiting; emaciation; tumor about gall-bladder; tapped and pus and blood drawn off. Duration one year. Cyst size of a child's head, due to dilatation of gall-bladder, cystic and hepatic ducts. Villous growths. Communication with the duodenum. Habershon, *British Med. Journal*, 1872.

CASE XLV.—Female, age fifty-nine. Symptoms of diabetic phthisis. At the neck of the gall-bladder the mucous membrane had formed a patch of thick, bulbous-ended papillæ, white and fleshy-looking; ducts normal. Two gall-stones and fragments in gall-bladder. Goodhart, *Op. cit.*

CASE XLVI.—Male, age fifty-six. Cylindrical epithelioma. From September 20th began to lose appetite and strength, gradually developed jaundice. The liver was large, without bosses;

no vomiting; constant pain radiating from epigastrium to abdomen; slight continuous fever; profuse perspiration; no ascites or œdema; great emaciation. January 31st; Liver very large and painful on pressure. Tumor at seat of gall-bladder; ascites. Death February 14th. Duration five months. Cause of death exhaustion. Secondary cancer of lungs; gall-bladder very large and full, walls formed by gelatinous tissue; colloid masses (small) in liver; microscopical examination of walls of gall-bladder: cylindrical cells and alveoli. Bertrand, *Thèse*, Paris, 1870.

Case XLVII.—Female, age sixty-six. Colloid. In September, 1869, pain in belly for first time, and some days later a painful tumor noticed in right hypogastrium. For one month intense jaundice; gradual loss of appetite and progressive weakness; hiccough; frequent eructations; no vomiting; stools decolorized; urine bile-stained; pain in right hypogastrium, not acute but persistent; tumor projecting in right hypogastrium, not rough but painful on pressure; some fever. Duration two months. Death from exhaustion. Large mass compressing liver, pancreas, and duodenum; liver very large in right lobe; ganglionic mass in hilum; gall-bladder much distended, walls thickened, yellowish-white; calculus in gall-bladder, and mucus and puriform matter; vegetation *en plaque* seen on removing calculus, situated near cystic duct, a little to right; tissue around it colloid; hepatic canals dilated; small fatty nodules on mucous membrane; similar nodules along bile-ducts of liver; small nodules in interior of ductus choledochus; pancreas healthy. Colloid vegetation. Bertrand, *Ibid.*

Case XLVIII.—Male, age fifty-eight. Pain in abdomen in December, 1855, followed by jaundice, and then paroxysm of pain stimulating gall-stone colic supervened. Diarrhœa. Moderate appetite. Emaciation. Ascites. General tenderness over abdomen. Duration nearly six months. Death from exhaustion. Healthy heart and lungs. Ascites. Dense white mass, hard, distended, size of ordinary gall-bladder, in position of gall-bladder. Gall-stones in cavity in centre of mass. Cystic and common ducts occluded. Adhesions to organs and contraction of mass. Bile-ducts dilated. Secondary growths on peritoneum, and in pancreas and mesenteric glands. Contracting mass pressed on vena portæ, and involved right semilunar ganglion, colon, duodenum, and gall-bladder. Habershon, Some Diseases of the Liver, Lettsomian Lectures, Philadelphia, 1872.

Case XLIX.—Female, age not given. Pain in right hypochondrium; vomiting; constipation; anorexia; somnolence; coma; icterus one week. Liver enlarged and painful on pressure. Duration seven weeks. Death from cholæmia. Cancerous degeneration of gall-bladder, cavity filled with many large stones; liver double normal weight; secondary nodules. Carpenter, *Pres. Med.*, 1876, xxviii. p. 12.

Cases L. and LI.—Sex and age not given. Ulceration and perforation of gall-bladder. Primary carcinoma of gall-bladder with gall-stones in both cases. Haas, *Prager Vierteljahrsschrift*, cxxxii. S. 131.

Case LII.—Female, age fifty-seven. Emaciation; cachexia; icterus three months; dyspeptic symptoms, vomiting; constipation; liver enlarged; tumor in gall-bladder region; ascites; ovarian tumor; pain on palpation; dysentery. Diagnosis—cancer of gall-bladder; ovarian tumor from rapid progress and cachexia. Duration one year. Death from dysentery. Gall-bladder enlarged; cancerous in one part, normal in the other; gall-stones and fluid; nodules in hepatic duct; mucous membrane of gall-bladder inflamed, not infiltrated; liver filled with nodules; glands about portal vein involved; ductus choledochus impervious. Kohn, Case XI., *Der primäre Krebs der Gallenblase*, Thèse, Breslau, 1879, p. 60.

Case LIII.—Female, age forty-five. Emaciation; cachexia late; icterus increasing; tumor hard, but at first elastic, movable, at gall-bladder; liver slightly enlarged, smooth; pain like colic; ascites; no gastric symptoms; diarrhœa late; spleen enlarged; pulmonary symptoms. Diagnosis—cancer of gall-bladder and cholelithiasis. Duration ten months. Death from exhaustion due to peritonitis from perforation. Gall-bladder at the fundus normal; the remaining half and the cystic and choledochus duct seat of cancer; gall-stones and pus in gall-bladder, with ulceration and perforation; dilatation and purulent infiltration of hepatic ducts; secondary deposits in liver, lungs, and glands. Kohn, Case XII., *Ibid.*

Case LIV.—Female, age fifty-two. Scrofulous; emaciation; cachexia; fever four months; hepatic colic and pain in tumor, which was of the size of a child's head, fluctuating at apex in gall-bladder region, attached to liver. Diagnosis—cancer of gall-bladder and ulceration; hepatic abscess eliminated. Duration five months, from hepatic colic. Death from exhaustion due to fever. Gall-bladder replaced by a cancerous mass, in centre of which a cavity communicating with the colon by ulceration; gall-stone in cystic duct; common duct dilated by passage of gall-stone; secondary deposit in liver. Kohn, Case XIII., *Ibid.*

Case LV.—Female, age forty-one. Scrofulous; cachexia; emaciation; slight icterus late; began with vomiting and pain in right hypochondrium and epigastrium; tumor growing from right lobe of liver; painful, uneven, hard; constipation; ascites; slight œdema. Diagnosis—hepatic cancer. Duration three months. Death in collapse. Gall-bladder enlarged and dilated; cancer toward the cystic duct, with small nodules about the fundus; part of cystic duct involved, part dilated and containing gall-stones; clear white thick fluid in duct and gall-bladder; secondary carcinoma in peritoneum, lung, pleura, and liver. Kohn, Case XIV., *Ibid.*

Case LVI.—Female, age fifty-one. Eight days before admission, hepatic colic, diarrhœa, and jaundice; emaciation; slightly enlarged liver; pain in hepatic region; thickening of border of liver, especially about gall-bladder and of spleen; diarrhœa and hemorrhages. Diagnosis impossible at first. Duration five and a half months. Death from hemorrhages. Gall-bladder walls replaced by new growth; bile passages dilated to periphery; liver green in color; carcinomatous deposit at junction of cystic and hepatic ducts; hemorrhagic nephritis. Kohn, Case XV., *Ibid.*

Case LVII.—Female, age seventy-seven. Debility, jaundice; liver enlarged and hard; in region of gall-bladder hard, painless, pyriform tumor of long duration; spleen normal; diarrhœa; ascites; œdema of lungs. Diagnosis—cancer of gall-bladder. Duration nine weeks.

Death from œdema of lungs. Gall-bladder and duodenum and colon attached; fistulous communication of gall-bladder and colon; fundus cystic, and choledochus duct affected; purulent fluid and cancerous debris in gall-bladder; ducts dilated; secondary nodules in liver and glands. Kohn, Case XVI., *Ibid.*

CASE LVIII.—Female, age forty. No clinical history; ascites; œdema of the legs; emaciation; no jaundice; no Addison's disease. Gall-bladder replaced by an indurated mass, cavity in centre containing gall-stones and pus; all organs in that region united; stone in common duct; ducts dilated and thickened; liver and lower supra-renal capsule containing secondary deposits; multiple hepatic abscesses. LangHeinrich, Case I., *Vier Fälle von Gallenblasen carcinom.*, Inaug. Dissertation, Halle, 1881, pp. 36.

CASE LXIX.—Male, age seventy-two. Vomiting six weeks before death. Debility; pain in abdomen: œdema of lungs; emaciation; dirty hue of skin (noted at autopsy). No diagnosis. Duration of active symptoms six weeks. Death from œdema of lungs. Gall-bladder hard and small, in cavity gall-stones, and in separate pocket a white fluid; liver congested; ducts bile-stained, also common and hepatic ducts; carcinoma of right adrenal; adhesion of gall-bladder to pylorus, liver, and vertebral column. LangHeinrich, Case II., *Ibid.*

CASE LX.—Female, age seventy. Icterus slight for some time; vomiting, the last week, stercoraceous with some continuous pain in right hypogastrium; vomiting abated; stools became bile-stained. Death after severe abdominal pain; peritonitis. At fundus of gall-bladder a new growth adherent to colon; perforation of gall-bladder, no gall-stones; spleen and liver enlarged; the latter and glands in fissure infiltrated; ulceration and stricture of transverse colon. Purulent peritonitis. LangHeinrich, Case III., *Ibid.*

CASE LXI.—Female, age forty-eight. Emaciation; cachexia; pain in abdomen; fever; jaundice; tumor above and to right of navel, size of a fist, uneven, firm, movable, tender, continuous with liver; œdema; dyspnœa; vomiting; exhaustion. Duration five months. Death from exhaustion. Liver enlarged and infiltrated with cancerous nodules; cancerous abscess, or degenerated cancer, between stomach, small intestine, transverse colon, and abdominal walls, in which gall-bladder is included; gall-stone in centre. Kraus, Case I., *Ein Beitrag zur Casuistik und Symptomatologie des primären Gallenblasen Krebses.* (Leipsiger Dissert.) *Deutsches Archiv für klinische Med.*, Leipsig, 1883.

CASE LXII.—Female, age forty-three. Cachexia; slight icterus; tumor occupying half of right side of abdomen, extending two fingers below navel; liver enlarged and nodulated; pain severe; ascites; diarrhœa. Duration two months. Death from cholæmia. Gall-bladder walls thickened; gall-stones, ducts free; gall-bladder adherent to colon; secondary affection of lungs, liver, and glands in hepatic fissure. Kraus, Case II., *Ibid.*

CASE LXIII.—Male, age forty-five. Emaciation; exhaustion; jaundice after one month; liver small; tumor below and to right of navel, extending upward, hard, uneven; ascites; œdema; constipation; no pain. Duration sixteen months. Cancer of gall-bladder extending to cystic duct; thirty gall-stones; common and all other ducts dilated; liver small; gall-bladder and colon adherent; secondary deposits in stomach, liver, pelvic and lumbar glands. Kraus, Case III., *Ibid.*

CASE LXIV.—Age and sex not given. Emaciation; tumid abdomen; anxious expression; constipation; vomiting. Death from peritonitis. Gall-bladder replaced by a cancerous tumor; entire contents of lesser omentum being one cancerous mass, in the posterior surface of which are nodules and contained gall-stones; cancer of ascending colon. Belcher, *Dublin Quarterly Journ. Med. Sci.*, 1861, xxxi.

CASE LXV.—Female, age forty-eight. Encephaloid (?). Emaciation; jaundice; hemorrhage, hematemesis; vomiting; hard tumor, painful on pressure, in right hypochondrium; painful digestion. Duration five months. Place of gall-bladder occupied by a cavity in the liver, with irregular rugous walls, holding a sanious fluid, containing cholesterine and fat globules, and in a pouch a gall-stone; adherence to transverse colon and stomach, and intercommunication. Calmettes, *Bull. Soc. Anat.*, Paris, 1868.

CASE LXVI.—Male, age fifty-five. Scirrhus. Admitted September 26th. Five months before admission, began with epigastric pain; dull pain, especially after eating, with weak and painful digestion. Anorexia; no vomiting. Two and a half months later, noticed jaundice; stools decolorized, constipation; for five weeks color became darker; urine almost black. For three weeks diarrhœa, œdema, and emaciation. No fat in stools in a notable degree. Painful hardness at level of ribs (margin). Emaciation, and general anasarca. Death, October 29th, from anasarca and exhaustion. Duration, six months. Gall-bladder not distinguishable. Cystic duct enveloped in a mass, and, opening it up, came upon a small cavity at border of liver, surrounded by hard pale tissue, and containing twelve calculi. Scirrhous carcinoma of gall-bladder, local. Oettinger, *Prog. Med.*, 1885, 25, i. 414.

CASE LXVII.—Female, age thirty-nine. Villous (?). Emaciation, jaundice, ascites, and anorexia. Liver hard and irregular; hard tumor on the anterir border size of walnut. Liver enlarged and yellow-green, soft, and granular. Gall-bladder size of a pear; in a pouch a mucoid fluid. Tumor at base and neck of gall-bladder. Hepatic artery and vein and common duct obstructed by tumor. Hepatic and cystic ducts dilated. Lymphatics dilated. Planteau, *Bull. Soc. Anat.*, 1875.

CASE LXVIII.—Female, age fifty-five. Colicky pain, emaciation, jaundice, anorexia, and ascites; no fever; peritonitis. Tumor in right hypochondrium, hard, size of walnut. Right lobe of liver enlarged. Diagnosis—cancer of liver. Duration six months. Death from peritonitis. Gall-bladder cancerous, dilated, forming various diverticula containing gall-stones; wall thickened. All ducts dilated. Liebman, *Rosoconto Sanitano dell' Osp. Civ. di Trieste*, 1876, 1-4, p. 211.

CASE LXIX.—Male, age fifty-seven. Anorexia, insomnia, anomalous symptoms, œdema of legs. Hard, indolent tumor in abdomen, reducible by pressure. Duration one year. Gall-bladder ulcerated internally; cancerous tumor of the walls, adherent to the aorta and vena cava. Liver enlarged and infiltrated. Ramon, *Medica Quirenzia*, Habana, 1879, v. p. 81.

CASE LXX.—Female, age thirty-eight. Hepatic colic; jaundice recurring and permanent. Tumor pyriform, size of child's head, elastic, attached to liver, movable with respiration. Liver normal; hemorrhages; emaciation. Death from peritonitis. Gall-bladder enlarged, cancerous, pear-shaped, adherent to stomach, and perforated; gall-stones in cavity. Koch, *Berlin. klin. Wochenschrift*, 1882, xxi. 299.

CASE LXXI.—Female, age seventy-four. Jaundice, and enlarged and nodulated liver. Ill six months. Gall-bladder enlarged. Cystic duct dilated to size of transverse colon, and contained 240 gall-stones; entrance occluded by one. Walls of gall-bladder thickened by new growth. Goodhart, *Atlas of Illust. Pathology*, Fasc. V., Sydenham Soc. Pub., 1882.

CASE LXXII.—Female, age sixty-six. Scirrrhus. For three weeks suffered with jaundice. Stone was felt for four weeks in gall-bladder. This disappeared, and in its place occurred an oblong, smooth, hard mass. Surface of liver uneven. Death from scirrhus of gall-bladder. Heitler, *Wiener med. Woch.*, 1883, No. 32.

CASE LXXIII.—Female, age seventy. Encephaloid. Feeling bad for eight months. Jaundice for two months. Pain severe in abdomen; latter enlarged; liver extending to crest of ilium; nodulated. Emaciation. Duration over eight months. Death from asthma. Gall-bladder enlarged, long. Walls about the neck about two centimetres thick. Eighteen gall-stones, one in a pouch. Gall-bladder adherent to stomach and colon. Liver cancerous, containing a hard nodule. Spleen normal. Leuf, *Proc. Med. Soc. Kings County*, Brooklyn, N. Y., 1883, viii. 291.

CASE LXXIV.—Female, age fifty-three. Onset sudden, two months before admission. Pain in epigastrium, liver, and shoulder. Rigors, vomiting; jaundice, after which pain and vomiting ceased. Fulness and tenderness over gall-bladder. On admission stout; a little ascites and flatulence, which increased. Lost strength. Duration, twelve weeks. Death from exhaustion. Body well nourished. Gall-bladder imbedded in a cancerous mass three inches across. Hard, yellow, mottled. Nodules in liver and lungs. Liver not much enlarged. Gall-bladder dilated and twenty gall-stones and pus within. Common duct enlarged. Cystic duct nearly obstructed. Two gallons of abdominal fluid. Murchison, *Brit. Med. Journal*, 1872, ii. p. 684.

CASE LXXV.—Female. History of gall-stones. Diagnosis—hepatic cancer. At first simulated ovarian cyst. Eighteen hundred gall-stones found. Gall-bladder thickened with cancer. T. Spencer Wells, "Lectures on Abdominal Tumors," *London Med. Times and Gazette*, 1878, i. 671.

CASE LXXVI.—Female, age fifty-one. Poor appetite, dyspepsia. Lancinating pain in right hypochondrium. Slight jaundice; fever. Tumor on right of umbilicus size of pigeon's egg; superficial, fluctuating, nodulated, and painful. Emaciation, anorexia, constipation, and cancerous cachexia. An incision to introduce a trocar showed nodular cancer of gall-bladder containing abundance of gall-stones. Duration about one year. No post-mortem examination made. Eustache, *Journ. Med. Sci. de Lille*, March 20, 1884, anne 7, No. 6.

CASE LXXVII.—Female, age sixty-nine. Scirrhus. Jaundice; enlarged liver; hard tumor, size of hazel-nut, movable with respiration; stools at first normal; later, no bile; no vomiting. Meteorismus forty-eight hours, with abdominal pain. Death from exhaustion. Scirrhus of gall-bladder and bile passages. At vertex of gall-bladder a "four-kreutzer" tumor. Metastatic knots in lymphatics—portal, hepatic, and mesenteric. Schrotter, *Bericht des K. K. Allgemeinen Krankenhauses zu Wien*, 1881–82, p. 23.

CASE LXXVIII.—Male, age thirty-eight. Encephaloid. Pain in back and over liver; jaundice. Tumor in region of gall-bladder, oval, immovable. Emaciation. Urine bile-tinged, dark. Feces light. Cachexia. Tumor size of walnut moved with respiration. Duration three months. Death from exhaustion. Gall-bladder dilated with bile, containing gall-stones. Coats thickened: serous coat not cancerous. Cystic duct obstructed at its origin by a stone. Liver and omental glands carcinomatous. Diaphragm adherent. J. W. Ogle, *St. George's Hospital Rep.*, 1868.

CASE LXXIX.—Female, age fifty-six. Well up to November, 1877, when she fell and struck the right side of belly. For some days afterward there was sensitiveness to pressure on right side. She then became aware of a lump in the right side over which the skin was bluish-green. Pain subsided, but the tumor remained, and grew steadily though slowly. Loss of strength and sleep. Some fever, vomiting, and hemorrhages. In latter days nausea. Deep jaundice. Prominent swelling in right side below navel. Tumor size of child's head, hard, round, uneven. Percussion between tumor and liver dull-tympany; over tumor abscess dull. First seen in May, 1878. Duration from occurrence of accident, about seven months. Death, June 22d, from collapse. Carcinoma of gall-bladder. Intestines lying between tumor and liver. Gall-bladder contained foul-smelling, dirty-colored fluid and a gall-stone. Tumor size of two fists. No recognized secondary deposits. A. Martin, *Berlin. klin. Woch.*, Nos. 22 and 23, 1879.

CASE LXXX.—Female, age sixty-seven. Cylindrical epithelial cancer. For three weeks pain in the belly, loss of apetite, and constipation. No fever. Abdomen slightly swollen. Liver dulness increased. Anterior border hard, knobby, extending in middle line to navel. No albumin in urine. Duration six weeks. Death from gradual failure in nutrition, with œdema and ascites. Cancer of gall-bladder, extending to liver. Metastases into the lungs, pleura, and lymph-glands. Adhesions to duodenum and transverse colon. Emphysema of lungs. Myocardium degenerated. Chronic endocarditis. Infarcts in spleen. Gall-stones from sixty to seventy. Zenker, *Archiv f. klin. Med.*, Bd. 44, Hefte 2 und 3, March, 1889.

CASE LXXXI.—Female, age fifty-six. Medullary cancer. Biliary calculi, secondary dilatation of bile-ducts, atrophy of liver. Numerous secondary deposits of cancer. Zenker, *Ibid.*

CASE LXXXII.—Female. Medullary cancer. Gall-stones. Ring-shaped growth. Zenker, *Ibid.*

CASE LXXXIII.—Female. Medullary cancer (?). Gall-stones. Zenker, *Ibid.*

CASE LXXXIV.—Female, age seventy-eight. Scirrhus. Scirrhus of navel, gall-bladder, head of pancreas, peritoneum, pylorus, ileo-cæcal valve, rectum, and uterus. Cancerous stenosis of the hepatic and common ducts. Gall-stones. Circumscribed cancer of left kidney, etc. Zenker, *Ibid.*

CASE LXXXV.—Female, age seventy-three. Scirrhus (?). Cancer of gall-bladder; cancerous degeneration of liver; purulent inflammation of gall-bladder, and abscess; gall-stones, etc. Liver atrophic. Zenker, *Ibid.*

CASE LXXXVI.—Female, age fifty-four. Scirrhus (?). Cancer of gall-bladder, liver, and mediastinal, epigastric, and retro-peritoneal lymph-glands. Gall-stones. Zenker, *Ibid.*

CASE LXXXVII.—Female. Cylindrical epithelial carcinoma. Gall-stones. Zenker, *Ibid.*

CASE LXXXVIII.—Female, age forty-seven. Pain lancinating, continuous, increased by pressure, or by lying on left side. Digestive disturbances. Intense jaundice. Nutrition very bad. Abdomen enlarged, on right side especially. Tumor size of pigeon's-egg, smooth, hard nodular, and painful. Grew worse, and died cachectic. Death from exhaustion. Primary carcinoma of gall-bladder and ducts; secondary deposits in liver, testicle, pancreas, and mesentery; hemorrhagic ascites, entrorrhagia, and jaundice. F. Fazio, *Giornalle Internaz. delle scienze Mediche*, 9, 1887, 385–397.

CASE LXXXIX.—Male, age forty-nine. Taken suddenly, June, 1886, with epigastric oppression, and became jaundiced. Stools decolorized. No pain in hepatic region. Digestive symptoms nearly five months. Later, some colic, much itching. December 1, 1886, apyrexia, jaundice, emaciation, bile pigment in urine; sub-umbilical region tumefied; no ascites. Ascites developed in a few days. December 25th, coma, and death from cholæmia. Duration about five months. Liver much enlarged; weight 2180 grammes; surface yellow. About a dozen small white points penetrate surface. Organ hard. At neck of gall-bladder tumor size of large chestnut, which encloses the cystic and common ducts Gall-bladder very small, contains no calculi. Bernheim and Simon, *Revue méd. de l'est*, Nancy, 1887, xix. 492–500.

CASE XC.—Male, age fifty-six. Scirrhus. Entered hospital April 6, 1885. Three years before he noticed a tumor size of egg just below false ribs on right side of mammary line. Grew steadily, always painless. Patient felt no sickness until three months ago (February, 1885), when health began to decline; digestion painful and disturbed; vomiting, emaciation; scanty urine, constipation. Never had hematemesis, pain over liver, or colic. On admission, jaundice; some small glands in groin on each side. Below liver large tumor, painless, round, fluctuating. Sudden death, April 12th, from syncope. Liver and gall-bladder weighed 2 kilogrammes 200 grammes. Gall-bladder size of cocoanut, walls flabby, degenerated, scirrhous; contained 200 grammes of liquid holding in suspension clot size of egg. No calculi in gall-bladder. Secondary granulations in liver. Scirrhus tumor size of walnut in pylorus. No dilatation of stomach. Heart pale and flabby; right auricle very notably dilated. Cénas, *La Loire médicale*, 1888, 6, 141–146.

CASE XCI.—Female, age sixty-eight. Scirrhus. Gall-bladder converted into a solid mass of new growth, of irregular pyriform outline four inches by one and a half inches. At larger end a cavity about size of a shelled walnut, and containing a single faceted gall-stone. This cavity is all that is left of gall-bladder. Secondary nodules in liver, left lung, intestines, and mesenteric and retro-peritoneal glands. Wigglesworth, *Medico-Chirur. Journal*, 1887, vii. 217.

CASE XCII.—Male, age forty-two. Scirrhus. Dull, aching pain, increased by pressure and unaffected by food, at intervals for years. Admitted to Melbourne Hospital January 19, 1887. Six months before felt a "nasty sickly sensation" come over him. Next day icterus. In a few days nagging pain in right hypochondrium, "shooting, and taking his breath away." Lost fourteen pounds in six weeks, and then entered Melbourne Hospital. Then deeply jaundiced, weakness, debility, dyspeptic symptoms. Bowels open, stools pale-drab and putrid. Kicked in liver region seventeen years before. Pain since then. Exploratory operation February 26th. Death March 1st. Gall-bladder converted into a scirrhous mass. Stomach held a large quantity of dark fluid like coffee-grounds. Deposit of new growth in walls of stomach near pylorus, but pylorus quite patent. Hepatic ducts greatly distended. Numerous small, pale, secondary deposits in liver. No mention of gall-stones. No marked disease in other organs. Robertson and Fitzgerald, *Austral. Med. Journal*, 1871, n. s., 9, pp. 221–23.

CASE XCIII.—Female, age fifty. Encephaloid. Acute pain in right side for five or six months. Shortly afterward swelling in epigastrium and right flank, which increased. Flesh preserved. Loss of strength, digestive troubles. Only since a year frequent vomiting, especially after food. Liver enlarged, prominent, hard, woodeny, especially at xiphoid; elsewhere smooth and even. No trace of jaundice, slight earthy hue. No trace of pigment in urine. In last days tongue coated, black; temperature raised; at times cerebral excitement and delirium. Death in coma, from cholæmia. Encephaloid of gall-bladder. Secondary nodules in liver, which weighs 5 kilogrammes 190 grammes. Gall-bladder enormously distended, and filled with calculi—forty counted. Examination of other organs negative. Lancereaux, *Sémaine médicale*, 7, 1887, 334.

CASE XCIV.—Male, age fifty-five. Scirrhus. Five months before death, began with digestive troubles, characterized by epigastric pain and a special slowness of digestion, eructations, and constipation. Later, intense jaundice, liver increased in volume: no ascites; diffuse induration at right false ribs. Rapid progress of disease, progressive weakness. Duration, five months. Gall-bladder only attacked: shrunken, filled with calculi, walls scirrhous, forming a characteristic hard mass which compressed hepatic duct. Lancereaux, *Sémeine méd.*, 7, 1887, 334.

CASE XCV.—Male, age forty-five. Admitted September 18, 1888, with well-marked jaundice and swelling of abdomen. Had been well up to preceding May, when he began to get yellow, and then became steadily more so. No pain. Three weeks before admission felt pain in epigastrium following food, and lasting three hours afterward. Bowels costive. No hepatic colic. On admission, in addition to above symptoms, he was ascitic; temperature normal, no pain or tenderness on pressure over liver; stools clayey, almost white. Urine dark reddish-brown, and containing bile pigment; no albumin, acid. On October 5th, vomiting coffee-grounds. Hiccough distressing. Death October 6th, from exhaustion. Duration about five months from appearance of jaundice. Gall-bladder hidden by mottled condition of adjacent organs. Section of whole mass discovered a cavity representing the gall-bladder, filled with twenty-six gall-stones, one blocking commencement of common duct. Secondary deposits in liver, head of pancreas, and pylorus. Garstang, *Lancet*, 1888, ii. 963.

CASE XCVI.—Male, age sixty-four. Medullary. Six weeks before second admission, jaundice, swelling and pain of liver, and much distended gall-bladder. At second incision, in site of gall-bladder, a deeply-contracted spot. Believes there were gall-stones, which were subsequently discharged. Died after eight days' treatment, October 19, 1869, much exhausted, and extremely jaundiced. Gall-bladder shrunken to size of hazel-nut, thick-walled, adherent to surrounding indurated capsule. Connected with ductus choledochus by a short, moderately wide passage, and contains thick, broth-like, yellowish-brown contents. In fissure of liver ducts surrounded by a very thick, clear, yellow-colored induration, which extends tree-like into parenchyma of liver, and also into neighborhood of cystic duct and gall-bladder, to the convex surface of liver. No cancer elsewhere. A. Willigk, *Virchow's Archiv*, Bd. 48, 524.

CASE XCVII.—Male, age fifty-five. Pain in abdomen, vomiting, jaundice, and emaciation. Liver tender, not enlarged. Bradbury, *Lancet*, London, 1886, 1, 788.

CASE XCVIII.—Female, age thirty-six. Epigastric pain, and swelling in abdomen. Tumor —apparently movable kidney—beneath right lobe of liver, remarkably movable. Increase in size, health broke down. Three months later, persistent pain, jaundice, and emaciation. Duration, three months. Death from exhaustion. Cancer of gall-bladder, variety not mentioned. Landau, "Movable Kidney," Syd. Soc. Pub., 1889, cx. 325.

CASE XCIX.—Male, age sixty-five. Brother said to have died (æt. seventy-two) from "cancer of bile-duct." One year before death, fever, unable to work, loss of flesh, pain in liver region; later, jaundice, debility, emaciation, and anorexia. One week before death, vomiting. Tumor in region of gall-bladder, which disappeared a day or two before death, after copious emesis of mucus and bile. Duration, one year after symptoms. Death from exhaustion. In gall-bladder hard tumor attached to posterior surface of common duct. Gall-bladder scirrhous. No disease of other viscera. N. Bridge, *Chicago Med. Journal and Examiner*, 1887, xxxiv. 339.

CASE C.—Male, age forty-nine. Scirrhus. Some months before admission, sudden pain. Ten weeks before, acute pain in right shoulder, right side, and body, and vomiting. Jaundice one week. Said to have been a gall-stone. When admitted, intense jaundice, emaciation, and xanthopsia. Liver extended to umbilicus, surface smooth and tender. Gradually sank. Duration some months. Death from exhaustion. Liver weighed eight pounds. Cancerous mass of gall-bladder. No gall-stones. Liver invaded. Common duct pervious. Soft villous growth occluded common and hepatic ducts, extending along common duct to gall-bladder. Numerous secondary nodules in liver and kidney, but no where else. R. E. Carrington, *Trans. Path. Soc.*, London, 1884, xxv.

ABSTRACTS OF CASES OF PRIMARY CANCER OF THE BILE-DUCTS.

CASE I.—Female, age seventy-two. Bilious colic, vomiting, followed by jaundice. Death ten days after admission. Common duct closed by tumor. Ducts dilated. Gall-bladder contained calculi, but no bile. Said to be a "case of alveolar cancer of liver." Choupée, *Bull. Soc. Anat.*, Paris, 1872, 2 s., xvii. pp. 53–55.

CASE II.—Male. Cylindrical carcinoma (?). Admitted October, 1863. Up to four months well. At that time gastro-intestinal catarrh (apparently) and jaundice. Later, anorexia, weakness, increase in jaundice. Abdomen slightly sensitive on deep pressure in epigastric region. Slight œdema. Stools colorless. On November 16th, first fever, preceded by chill. Stools bloody. Two days later, death with symptoms of œdema of lung. Duration, five months. Liver moderately large. Gall-bladder distended. Cherry-sized red swelling, covered by unchanged mucous membrane, projecting into duodenum at mouth of common duct. Beyond duodenum, common duct dilated. Abscess foci along smaller bile-ducts. Tumor "cancroid, with cylindrical cells." S. Rosenstein, *Berl. klin. Woch.*, 1864, No. 34, pp. 336, 337.

CASE III.—Female, age forty-four. Mother died from cancer of uterus. Patient, about seven years before, had hepatic colic, which ceased three or four years, and recurred two years ago with greater intensity. Jaundice, anorexia, nausea, vomiting; stools fatty in color; urine deep-colored. Pain and weight in hepatic region. Emaciation, cachexia, ascites. Death six weeks after admission. During last days of life, intermittent fever. Round tumor below costal border painful—a distended gall-bladder. Gall-bladder distended and filled with calculi; adherent at neck to pancreas. At beginning of ductus choledochus, tumor size of a walnut surrounding portal vein and hepatic artery, and adhering to head of pancreas, tissue of which was normal. Liver very large; secondary growths; enormous dilatation of bile-ducts. Two large abscesses: one in right lobe, other under phrenic centre. Microscopical examination: dilatation of bile-ducts, some containing epithelioid cells. P. Segond, *Progrès Méd.*, 1880, 8, 811.

CASE IV.—Male, age sixty-eight. Itching for one week, followed by jaundice in one week. Intermittent fever for three weeks. Sharp rigor, lasting one hour, followed by fever, but no sweat. Improvement. Recurrence from slight causes. Last few days of life, fever constant.

Coma. No physical signs. Duodenum inflamed. Orifice of duct in duodenum surrounded by an irregular fungous growth. Hepatic and bile-ducts dilated. Gall-bladder distended with bile. Stokes, *Dublin Quart. Journal*, 1846, ii. 595.

CASE V.—Male, age thirty-five. Cylindrical epithelioma. Dyspeptic symptoms April 1st. Jaundice during April and May. October 21, liver enlarged; urine contained bile pigment, feces black; hemorrhagic tendency great, especially subcutaneous. Evening fever. No tumor, and no evidence of cancer. Duration, six months. Liver enlarged and firm. Dilated ducts, ceasing near porta; here both hepatic and common ducts have thickened walls, firm, hard, uniform yellow-gray. Common duct and gall-bladder collapsed, but unaltered. Key and Wising, *Med. Rec.*, London, 1881, ix. 464, from *Hygeia*, 1880.

CASE VI.—Male, age forty-nine. Scirrhus (?). Dyspeptic for fifteen years. Pain in stomach, possibly biliary colic. Three months ago, cramp in stomach, vomiting; next day jaundice. July 17th, deep jaundice, emaciation, itchy; pain in epigastrium, extending to right shoulder; loss of appetite; stools colorless. Tumor in region of pylorus. Carcinoma of gall-duct, which contained gall-stones. Liver not enlarged. Secondary sarcomatous nodules in liver. Gall-bladder contained nineteen gall-stones. No carcinomatous nodules found in the other organs. J. Krause, *Prager med. Woch.*, 1884, ix. 483–485.

CASE VII.—Female, age sixty-two. Jaundice, ashen stools; later, ascites and œdema, emaciation. Liver enlarged, smooth, only slightly painful on palpation. Abdomen distended, walls thin. Pneumonia, and death. In common duct, near junction of cystic and hepatic ducts, cherry-sized tumor, and walls infiltrated; calibre contracted. Another hard tumor in track of hepatic duct, imbedded in liver. J. Schreiber, *Berl. klin. Woch.*, 1877, 445–447.

CASE VIII.—Male, age fifty-one. August, 1866, choleraic attack, followed by jaundice. December, liver enlarged downward; some pain on percussion or palpation. Stools grayish. January 25, 1867, profuse hematuria, lasting two days. February 17th, hemorrhage from gums. February 24th, profuse hemorrhage. March 18th, epistaxis, arrested on the 20th. Death on the 25th, from exhaustion. Duration, seven months. Lower edge of liver presented a lardaceous induration, of cancerous appearance. Ducts greatly dilated, and liver full of bile. Stricture of hepatic duct. Gall-bladder doubled in size. Microscopical examination of stricture shows that tissue is cancerous. Secondary cancers of liver. Laugier, *Bull. de la Soc. Anat.*, 1867, 277.

CASE IX.—Female, age fifty-seven. Entered August 12, 1838. Eighteen months before, following an attack of pneumonia, she perceived a large tumor in right hypogastrium, pretty deep, not at all painful. In the winter of 1837–38 apex pneumonia; tumor in right hypogastrium hard, size of pigeon's egg, rounded, not nodular, not painful. Liver not enlarged. No jaundice. On August 12th, had had jaundice for fifteen days; no taste for food; thirst, constipation, stools decolorized. Tumor size of hen's egg, very slightly painful. Irregular fever, great emaciation. Jaundice deepened, and emaciation increased. About six weeks after admission vomiting increased in frequency. Progressive emaciation and feebleness. Pain in paroxysms. Symptoms of tuberculosis of lungs. Death, Nov. 12th, from exhaustion. Duration, twenty-one months. Tuberculosis at apex of left lung. Liver large, nodulated, soft, yellowish. Cancerous tissue, especially at base, around bile-ducts. Gall-bladder distended, contained calculi. Bile-ducts enveloped by cancerous matter. Ductus choledochus entirely replaced by a soft, whitish matter. Hepatic duct dilated, and contained calculi. Durand-Fardel, *Archives gén. de Méd.*, 1840, viii. 179.

CASE X.—Female, age eighty-one. January 31, 1838, she entered for symptoms of strangulated bowel. There was no jaundice. She died in June, extraordinarily emaciated. Skin had been dry and earthy, never covered with sweat. Ate little, but no vomiting. Gradual and profound failure of the vital forces, and extreme anæmia. Duration, four and a half months. Death from exhaustion. Enormous dilatation of bile-ducts throughout liver. Gall-bladder contained calculi. Fungous cancer at duodenal orifice of ductus choledochus, size of small nut, appearing like softened scirrhus; occupied almost the lower fourth of it. At the upper part of this tumor was a small stone like those of the gall-bladder. Dilatation of hepatic canals. No organ had a vestige of cancerous degeneration. Durand-Fardel, *Archives gén. de Méd.*, 1840, viii. 187.

CASE XI.—Female, old. Scirrhus. Chronic jaundice for one and a half years. No hepatic colic, but frequent vomiting at beginning of disease. No tumor revealed by palpation. Liver large. Urine deep in color, frothy, contained albumin and bile. Stools decolorized. Duration, one and a half years. Gall-bladder contained a large number of calculi. Large calculus obliterated cystic and common ducts, walls of which are seat of a hard tumor—scirrhus. Intra-hepatic bile-ducts dilated. Secondary growths in peritoneum and mesenteric glands. Glorie, *Bull. de la Soc. anatomo-clin. de Lille*, 1887, ii. 201.

CASE XII.—Female, age sixty-six. Scirrhus. Toward age of fifty-seven had, for about five years, epigastric pains radiating into shoulders. Subject, for two years, to digestive troubles. Entered hospital, April, 1886, for jaundice dating back fifteen days, accompanied with decolorization of stools, and followed by progressive enlargement of liver. Twelve days afterward daily attacks of fever—intermittent. Weakness; tumor toward edge of liver; deeper jaundice, nocturnal delirium, watery vomiting, profuse diarrhœa, marasmus; death from exhaustion more than two months after appearance of first symptoms. Duration, two and a half months. Primary cancer of bile-ducts, with constriction of hepatic duct by scirrhous infiltration of walls. Gall-bladder atrophied, intra-hepatic bile-ducts considerably dilated; consecutive biliary cirrhosis. Profuse hemorrhage into pericardium. Bernheim and Simon, *Revue méd. de l'est*, Nancy, 1887, xix. 492–500.

CASE XIII.—Male, age thirty-six. Medullary. In June, 1857, attacked with vomiting and purging. No history of gall-stones. On July 17th hepatic pain, anorexia, thirst, lassitude, chalky stools; urine loaded with bile; liver enlarged and tender. August 4th, jaundice bad. September 1st, intense jaundice, pain in hepatic region, tenderness. No irregularity of liver. September 15th, tumor in right iliac region, tender, dulness continuous with that of liver. One

week afterward sudden coma and delirium. October 21st, death from exhaustion. Duration, four months. Liver, sixty ounces. Gall-bladder distended. Common bile-duct distended, size of man's thumb. Ducts in liver dilated, containing fluid like barley-water. Common bile-duct obstructed by medullary cancer growing from internal surface. Large cancer (orange-size) in head of pancreas, pressing on, but not obstructing, common duct. Growth in duct did not arise by continuity from that in pancreas. Van der Byl, *Trans. Path. Soc.*, London, ix.

CASE XIV.—Male, age seventy-four. Encephaloid. Abdominal pains for two or three years, principally in right hypogastrium, several times followed by jaundice. Entered March 9th. Four days afterward, pain in right hypogastrium and icterus, loss of flesh. Tenderness over liver on pressure, dulness increased, stools grayish. Deepening of jaundice, diminution of strength. Death in marasmus, and ascitic, April 24th. Ductus choledochus has fungoid excrescence—encephaloid cancer—near spur formed by union of cystic and hepatic ducts. Growth obstructs canal. Thrombosis of portal vein. Numerous cancerous "stones" on surface of liver. No other growths. Heart fatty and flaccid. Boucheret and Cossy, *Bull. de la Soc. Anat.*, 1873.

CASE XV.—Male, age forty-nine. Was taken sick in July, 1887, with cramp in stomach and vomiting; jaundice gradually developed, and reached its height in December, 1887. Jaundice accompanied by itching; epigastric pain. Improvement; relapse, with intermittent fever, enlarged liver and gall-bladder, which contained serum. Gall-bladder tumor, distention of abdomen, emaciation, gradual loss of appetite. October 15, 1888, laparotomy, followed by death. Primary carcinoma of common duct, with diseased walls and occluded lumen. Secondary nodules in head of pancreas and in liver. Gall-bladder contained sero-purulent fluid and bile. Cystic duct closed by cancerous mass. J. H. Musser.

CASE XVI.—Male, age forty-seven. Jaundice began about June 12, 1886. Had none before, nor any serious illness. Jaundice came on after a few days' pain in epigastrium, after taking food, and without any colic. Said he had been losing flesh slightly for two years. Edge of liver not felt when admitted, July 22, 1886. Became better, but returned worse, and was readmitted October 8th, much thinner and deeply jaundiced. Gall-bladder distinctly felt, and it slowly increased in size. Duration, from appearance of jaundice, about five months. Entire duration, two and ahalf years. Carcinoma of common duct, starting from large epithelial cells of common duct. No infiltration of liver, and no secondary deposits in liver or any other organ. Dilatation of gall-bladder. N. Moore, *Trans. Path. Soc.*, London, 1888, xxxix. 142.

CASE XVII.—Female. Pain in epigastrium at intervals for two years, and after losing flesh for two months became jaundiced June 15, 1886. Admitted to St. Bartholomew's July 6th, when she was deeply jaundiced, but edge of liver not felt. Some weeks later, jaundice deeper, and gall-bladder felt as a hard lump. More and more jaundiced, weaker. Death December 4, 1886. Duration about two and a half years. From appearance of jaundice, about six months. Carcinoma of common bile-duct. Dense whitish mass occluded common and cystic ducts. Gall-bladder occluded, adherent to walls of a small hydatid cyst. No secondary deposits in liver. Bile-ducts dilated. Liver cirrhotic. N. Moore, *Trans. Path. Soc.*, London, 1888, xxxix.

CASE XVIII.—Female, age fifty-eight. Encephaloid. Jaundice, preceded by loss of flesh, nausea, and vomiting, had developed gradually in October, 1887. Died at St. Bartholomew's, February 14, 1888. No history of biliary colic. Had pericarditis, febrile symptoms, and delirium before death. Duration, four months. Just below junction of cystic and hepatic ducts, common duct was blocked by a mass of soft, whitish, sprouting new growth. Duct above enormously dilated. Gall-bladder distended with a puriform fluid, and contained several gall-stones. No stones in ducts. No new growths in liver. J. A. Ormerod, *Trans. Path. Soc.*, London, 1888, xxxix.

ABSTRACTS OF CASES OF SARCOMA OF THE GALL-BLADDER.

CASE I.—Female, age sixty-two. Sarcoma. Emaciation, exhaustion, jaundice, nausea, and vomiting at times; ascites; liver six inches below ribs. Tumor, fluctuating, in iliac fossa. Duration, several months. Cystic duct infiltrated; calibre increased twelve times; common duct and abdomen involved. Ducts in liver dilated. Retention cysts; no stones. Boutwell and Ford, *St. Louis Med. and Surg. Journ.*, 1879.

CASE II.—Female, age fifty-five. Spindle-celled sarcoma. Pain; liver enlarged. Emaciation, exhaustion, constipation. Tumor hard, round, fixed, extending from inferior surface of liver to umbilicus. Duration, three months. Gall-bladder buried in a mass, oval, whitish, in epigastrium and right hypochodrium, invading right lobe of liver, pancreas, and colon. Hepatic and cystic ducts involved, but pervious; gall-stones. Ingalls, *Boston Med. and Surg. Journ.*, 1878.

CASE III.—Male, age fifty-two. Sarcoma. Gastric disturbance for several months; anorexia. Tumefaction over hepatic region rapidly increased. Death from peritonitis. Gall-bladder involved in a spongy, dirty mass, size of a man's head. In a cavity one hundred gall-stones. Disease primary; no metastases. Seibert, *Med. Record*, N. Y., 1882, xxi. 299.

THE ANATOMICAL RELATIONS OF LESIONS OF THE HEART AND THE KIDNEYS IN BRIGHT'S DISEASE.

FROM THE STUDY OF THREE HUNDRED AUTOPSIES.

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IN the present paper I give an account of my studies from three hundred autopsy records of Bright's disease.

I will limit myself chiefly to the consideration of hypertrophy and fatty metamorphosis of the heart as occurring in this disease. There are a number of other points of interest that may be gleaned from these records, but upon which I will not dwell now beyond stating general results.

Some of the points gained from the analysis of my tables give results which are at variance with those obtained from the collective studies of cases of Bright's disease made by some authorities. The reason for this may be looked for, however, in the classification of the material, the direction of study, or the purpose for which any given class of cases had been collected, or sometimes selected.

My studies are purely morphological, being made at the autopsy table and in the laboratory upon consecutive cases of Bright's disease as they occurred during a given space of time. They are unbiased; not being a clinician, I have no theories or hypotheses to follow out, and refrain from making any suggestions regarding the mechanism of the production of cardiac and renal changes, and for the present I will not go into the details of the etiological relations of these affections.

Of the three hundred autopsies upon cases of typical Bright's disease, one hundred and fifty were studied by myself post-mortem, and most of these also microscopically; in fact, the specimens from

every case where the naked-eye appearance was not conclusive, were thus examined. The source of these one hundred and fifty autopsies is from the coroner's material of the city of Philadelphia, through the courtesy of Coroner S. H. Ashbridge, for whom, in conjunction with Dr. R. R. Stewart, I conduct all the autopsies of cases of sudden deaths or those unattended by physicians. Another source is private autopsies, which I frequently make at the request of physicians. All these cases occurred in a total of eleven hundred and seventy-two consecutive autopsies of adults, and were executed between September 1, 1888, and September 1, 1889. It will be seen from the tabulated results given below, that in general these cases are not unlike the hospital cases, which are not included in this series.

The other one hundred and fifty autopsies were taken from the post-mortem records of the Philadelphia Hospital (the large almshouse hospital of this city). I abstracted them with the aid of my assistant in this work, J. F. Spelman. They are all cases of typical Bright's disease, mostly diagnosticated as such or studied during life, being selected from a total of thirteen hundred autopsies from the hospital records stated, covering a period of five years. Many of them had been executed under my supervision and that of Dr. E. O. Shakespeare, while the rest were clinically studied and executed by the members of the hospital staff, which included Drs. Tyson, Bruen, Osler, Musser, Wilson, Henry, Curtin, and Walker.

These hospital records, although not sufficiently detailed regarding the weight of the heart and kidneys, are accurate and will serve our purpose. Each series of cases is separate and distinct, no cases being duplicated.

Each of the two series of autopsies is recorded in detail, separately in the second part of this paper.

In the preparation or collection of these records, Bright's disease was taken as the starting-point or basis. All cases of kidney affections other than Bright's disease, or those in which the disease did not present itself as fully established at the autopsy, and a few ill-recorded cases, were excluded.

In the hospital and private cases the clinical diagnosis was paid attention to, an advantage which was not enjoyed in the coroner's cases, yet, even in the latter, sometimes the most truthful of histories

were obtained under oath upon the witness stand, especially regarding habits of the deceased.

In the series of my own autopsies, which were made with the special purpose of presenting the results in these studies, the weight of the heart and of the kidney were taken carefully in nearly every instance as stated in the records, likewise the condition of the *body*, while its weight was approximately estimated and which, I believe, in most cases to be an almost true estimate, being correct within the limits of a few pounds. Naturally the ability to do this requires practice.

The estimation of the weight of the body is all-important as regards the question of the normal size of either heart or kidneys, because while a heart weighing twelve ounces may be called hypertrophied in an individual of one hundred and twenty pounds bodily weight, it may be considered of normal weight in an individual weighing two hundred pounds. My figures of the approximate weight of the body are satisfactory for this purpose, because a mistake within a few pounds (of the bodily weight) could be no definite mathematical factor; moreover, there are other more serious obstacles to the precision in calculating proportions, such as the condition of nutrition of the body and the contents of the alimentary canal.

In all statistics relating to the weight of the heart found in the literature of Bright's disease these points, the importance of which is readily seen, have not been taken into consideration by any one in this class of studies as far as I know. The same is true of the relation of the kidneys to the bodily weight in Bright's disease.

From the given weight of an organ a satisfactory estimate of its size can be made. I found the weight of organs to be a much safer criterion and more satisfactory than measurements, the latter being made by the different observers according to various scales, methods, and ideas, which are often quite unintelligible and useless. The heart muscle especially varies in thickness according to the degree of contraction, the quantity of clotted blood, and the time which has elapsed since death. The plain statement of an experienced observer as to the condition of the cavities, the walls, and the approximate weight of the heart is more valuable than all the measurements that an inexperienced and over-zealous one will present with his figures.

From the present considerations I exclude amyloid disease of the

kidney; although belonging to the picture of Bright's disease, there is a marked and nearly constant apparent absence of hypertrophy of the heart. This is true as far as the small size or weight of the heart is concerned at time of death, but if it be considered that we meet with it usually in scrofulous subjects, who have invariably congenitally small hearts, the conclusion that hypertrophy of the heart is rare in this affection will be found in error.

The small heart of the scrofulous is subject to hypertrophy as well as the heart of the normal individual; but when the former hypertrophies to double its original size, it may not appear any larger in volume than the latter, or when, in reality, enormously hypertrophied it may barely reach the size of what we ordinarily would call a slight hypertrophy. I made some studies upon the weight of the organs, in relation to the size of the body, in the scrofulous, according to the methods of Beneke and Thoma for establishing such weights, and paid especial attention to hypertrophy in amyloid disease. I shall present these observations on another occasion.

Cases of congenitally small kidneys and of senile atrophy were carefully excluded in Series A., these autopsies having been executed all by myself or the organs personally studied.

I also excluded from the present records cyanotic induration of the kidneys; this, as is well known, is usually the consequence of cardiac disease, especially valvular. I may state here that my researches have fully convinced me that cyanotic induration of the kidney never terminates in Bright's disease, which is quite contrary to the opinion of some observers. I have reference to the long-standing passive hyperæmia of the kidneys which results in cyanotic induration of these organs, with enlargement to often double their size, the kidneys being hard and firm and bluish-red in color.

The alcoholic cyanosis of the kidney, another affection analogous morphologically to the last named, but different only in the shape of the organs (the "pig-backed" kidney, which I first described and demonstrated before this Association (see Vol. I. of *Transactions*), I also excluded). Alcoholic cyanosis is often associated with cardiac hypertrophy, but rarely with valvular disease. It is this affection which is often mistaken on the post-mortem table for, and recorded as, acute Bright's disease. I doubt not that this lesion (the alcoholic kidney) represents the inflammatory form of Bright's disease of

Grainger Stewart, which he records as being without albuminuria, without dropsy, and with large fatty livers, and which has crept now and then into the records of various observers, old and recent, as cases of acute Bright's disease. I also believe some of the subdivisions of the "pluralists" on Bright's disease, such as the "chronic hemorrhagic nephritis without dropsy of Weigert," to be identical with my alcoholic cyanosis.

The late stage of the alcoholic cyanosis (the œdematous form), as met with upon the post-mortem table, in chronic drunkards who had been deprived for some time of alcoholic beverages, resembling much the large white kidney macroscopically, is another source of error; this lesion I have seldom seen to give rise to left-sided hypertrophy, though general hypertrophy is common.[1]

Amyloid kidney also closely resembles and is often mistaken for the large white and the fatty and contracted kidney.

Such mistakes and the omission (to be referred to later) of some authors to separate the fatty and secondarily contracted kidney from the primarily contracted or granular kidney, cripple the statistics on the subject of hypertrophy of the heart quite decidedly.

In recording my cases I have adopted the rather crude and old-fashioned nomenclature for the various forms of Bright's disease, but one which I am sure will be readily comprehended; whereas, did I use the proper technical terms, misunderstanding on the part of the reader, as to the exact form of Bright's disease meant, would be sometimes liable to occur.[2]

The classification adopted is as follows:

I. The *acute parenchymatous nephritis* (*syn.* catarrhal, tubular, desquamative, croupous, scarlatinal, febrile, glomerulo-nephritis, acute degeneration of the kidney, acute exudative nephritis, acute diffuse nephritis) I will term *acute Bright's disease.*

[1] It is remarkable how infrequent Bright's disease is in drunkards. I found that inflammatory kidney lesions generally occurred more frequently in the temperate than in the intemperate. Is it the constant excess of venous blood in cyanosis of the kidneys that makes inflammatory changes in the latter less frequent, like it does in the right chambers of the heart?

[2] I am not considering here the histology of Bright's disease, hence it is unnecessary to review the anatomical and histological features of the various forms of this affection; but stating the array of synonyms may avoid misunderstanding.

II. The *early stage of the chronic parenchymatous* nephritis (*syn.* same as above qualified by "*chronic*") I will invariably call *large white kidney*, which well expresses the stage of the disease.

III. The *late or contracting stage of the chronic parenchymatous nephritis* (*syn.* diffuse nephritis, secondarily contracted kidney, obstructive nephritis, fatty kidney, chronic diffuse nephritis with exudation) I will designate as *fatty and contracted kidney.*

IV. The *chronic interstitial nephritis* or primary contracted kidney (*syn.* granular, cirrhotic, and gouty kidney, renal cirrhosis, atrophic, lithæmic and toxæmic nephritis, and chronic diffuse nephritis without exudation, etc.) I will call *red granular kidney*, which is an old and comprehensive name for this affection.

Among the most serious sins of nomenclature we find that the term diffuse nephritis is indifferently applied to both the fatty and contracted and the red granular kidney.

The reasons for a separation of these two affections as distinct forms of Bright's disease are quite obvious, and I put myself strongly on the side of those who make it, viz., the dualists. [1]

For diagnostic purposes and for prognosis it is also quite essential that the *fatty or secondarily contracted kidney* should be differentiated from the *red granular or primarily contracted kidney.* Clinically it is, I believe, well established, that in the former the onset of the disease may nearly always be traced to acute nephritis, or at least to the large white kidney; that it is liable to occur at all ages; that transitions from scarlatinal nephritis in the young are traced to the large white kidney of the adult, and to the fatty and contracted kidney of late life, while rarely to the very old; that dropsy is very common in the

[1] It is interesting to observe that the father of Bright's disease, also Grainger Stewart, Dickinson, Johnson, and the English school are strictly "dualists," being reinforced by the great original German workers Virchow, Traube, Senator, and Bartels; Charcot and Cornil in France, and in this country perhaps strongest by Tyson. The French are mostly "unicists" (*i. e.*, advocates of the eventual transition of the three parenchymatous forms of nephritis into the red granular kidney), which is, however, also in accordance with the views of such prominent Germans as Frerichs, Rosenstein, Cohnheim, and Bamberger, and it appears also with the views of some of the New York authorities on the subject.

Of late years "pluralists" have arisen, chiefly among the Germans, including Wagner, Weigert, and even Senator, who are inclined to ascribe every form of Bright's disease to different and independent morbid processes and causes, and place several complications of the morbus Brightii in the field as independent subdivisions of the disease.

earlier stages; that polyuria is more rare, and albumin is seldom missed; in fact, the duration of the disease is very uncertain, a fatal termination being liable to occur at any time.

On the other hand, in the *red granular kidney*, which is common in gouty and rheumatic individuals, and is so often traced to disease of the genito-urinary tract, the initial stage is unknown, there being nothing to show that an acute inflammation of the kidney ever existed. It rarely occurs in the young,[1] being almost peculiar to middle or old age; it may be of lifelong duration; dropsy and presence of albumin are rare, and polyuria is prominent.

Polyuria in the fatty and contracted kidney, if it occurs at all, is late; the urine may be rich in albumin, whereas, in the ever-present copious flow in the red granular form little or no albumin is present, as is well known. This, I believe to be an important diagnostic point.

In my laboratory classes the urine examined is often from well-known clinical cases, and in many instances have I traced the albuminous (fatty and contracted kidney) and non-albuminous polyuria (red granular kidney) to the post-mortem table.

I may be permitted to introduce the following table relating to the more important anatomical and microscopical differences between the two affections referred to, because their separation is to a certain extent a point of issue in hypertrophy of the heart, and fatty metamorphosis of the cardiac muscle.

Fatty and Contracted Kidney.	*Red Granular Kidney.*
Contraction of kidney secondary.	Contraction of kidney primary.
Size seldom below normal.	Size below normal, often reduced to one-half, or even one-fourth.
Capsule adherent only in places, seldom thickened. Surface lobulated, often smooth; color pale, mottled or yellow.	Capsule adherent, thickened. Surface granular, rough. Color red or grayish-red.
Cysts usually large, and seldom numerous. Pelvis rarely dilated.	Cysts usually small-sized and numerous. Pelvis often dilated.
Arterial changes rare, or not pronounced.	Arterial changes (endarteritis, or periartritis) almost invariably present.
Cortex often normal in size. Atrophy very late.	Cortex always much atrophied.

[1] Eight cases below 30 years will be found in my records. Histories of syphilis, malaria, and anæmia were conspicuous in these cases. For duration of life in Bright's disease, see special table.

Renal epithelium much swollen, desquamating freely, often in a state of fatty degeneration, but cells always visible. Compound granule cells.	Renal epithelium never desquamating, though it may undergo fatty degeneration (necrosis), and become diminished in size and partly lost.
Tube casts epithelial, dark granular, and containing compound granule cells, and later fat globules.	Tube casts hyaline, pale granular, and waxy, but never containing cells, epithelial or any other.

NOTE.—If the classification and the definition of Bright's disease in its various forms were undisputed and a uniform nomenclature adhered to by all, then there would be no discrepancy in statistical results such as is seen in the literature of the subject. I would earnestly urge the adoption of a uniform nomenclature for the various forms of Bright's disease and the abolition of some of the synonyms. Some of the latter are misleading and I have met with instances where pathologists and clinical teachers would designate one and the same form of Bright's disease by entirely different names (without thinking that they were identical) and also under a certain given name affections entirely different from one another. Others delight in suggesting and using new names for the various forms without giving synonyms when writing on the subject, and leaving the reader to conjecture from the description which form of the affection they really mean.

ANALYSIS OF THE CASES.

The three hundred autopsies from which I draw my conclusions (two series: A. coroner's and private cases, B. hospital cases) are, as stated, recorded in detail in the second part of this paper (Appendix). I thought it necessary and convenient to record them here, as future studies of the same by anyone may reveal points of interest at present unconsidered. Each case has a reference either to my note-book, to the autopsy records of the Philadelphia Hospital, or to those of the coroner, so that should additional information be desired it may be gained therefrom.

The large general table is a summary of all the cases recorded in this paper, and gives the duration of life, the cause of death, the condition of the body, dropsy, cystic change of the kidney, and the prominent cardiac complications, such as hypertrophy, valvular disease, fatty metamorphosis, and dilatation of the heart, as well as the arterial changes in each form of Bright's disease, stating the number of cases. The figures expressing the percentage side by side with the number of cases, facilitate comparison with other statistics.

Beside this I have compiled several special tables which give interesting data relating to hypertrophy of the heart under varying conditions; fatty metamorphosis of the cardiac walls, valvular disease

and pericarditis, and the weight of the heart and kidneys in each of these affections.

I also present tables relating to age and sex, and further some interesting figures concerning the weight of the heart in relation to the weight of the body, and finally some data relating to the distribution of Bright's disease during the various periods of life.

References will be found in the records to arterial changes and a summary of the various complications or concurrent affections of Bright's disease.

CONCLUSIONS.

From the accompanying general table the following conclusions may be made:

HYPERTROPHY OF THE HEART.[1]

Hypertrophy of the heart in Bright's disease generally, occurred in all the cases tabulated in 62 per cent., of which 34 per cent. were left-sided and 28 per cent. were general hypertrophy. Hypertrophy was absent in only 38 per cent. of all cases.

Considering the two forms of Bright's disease apart, we find that general hypertrophy coexists more frequently with parenchymatous nephritis, viz., in 29 per cent.; while hypertrophy of the left ventricle alone was met with in 26 per cent. in this form of Bright's disease. Hypertrophy of the left ventricle predominates in interstitial nephritis, showing 44 per cent. to 26 per cent. of the parenchymatous. General hypertrophy occurred in interstitial nephritis in 28 per cent.

I obtained also figures which vary somewhat in the two series of cases tabulated.

Series A. Coroner's and private cases.—Hypertrophy of heart in connection with the parenchymatous forms of nephritis, occurred in 54

[1] To secure the figures stated below regarding cardiac hypertrophy, each of the two series of cases is first considered separately, viz., by adding the total number of cases of parenchymatous and interstitial nephritis together and dividing by 150; the two results then being added and divided by two. For instance—general cardiac hypertrophy, *Coroner's and private cases:* in parenchymatous forms of nephritis, 22 cases; in interstitial nephritis, 13 cases; a total of 35 cases, which equals 23 per cent. *Hospital cases:* parenchymatous forms, 28 cases; interstitial nephritis, 22 cases; a total of 50 cases, which equals 33 per cent. By adding the two results (23 per cent. and 33 per cent.) and again dividing by two 28 per cent. is obtained, which equals the percentage of general hypertrophy in the *total of cases.*

Analysis of 300 Cases of Bright's

Series A.

Results of Personal Observations from Coroner's and Private Autopsies.

		Parenchymatous Nephritis.								Interstitial Nephritis.		Total.	
		Acute Bright's.		Large white.		Fatty and contract'd		Total		Red granular.			
Number of cases of each form		10		44		46		100		50		150	
Average age at time of death		26 years		34 years		45 years		.....		52 years		.....	
		No.	pr. ct.	No.	pr. ct.	No.	pr. ct.	No.	pr. ct.	No.	pr. ct.	No.	pr. ct.
Cause of death,	uræmia,	0		13	30	19	41	32	32	15	30	47	31
	œdema of lungs,	0		9	20.5	5	11	14	14	13	26	27	18
	cerebral apoplexy	0		0		6	13	6	6	8	16	14	9
	pneumonia,	1	10	5	11.5	2	4	8	8	1	2	9	6
	pericarditis,	0		8	18	8	15	16	16	12	24	28	18.5
	hydropericardium	0		5	11.5	3	7	8	8	1	2	9	6
	heart failure,	0		3	7	3	7	6	6	2	4	8	5
	sudden.	0		2	4	3	7	5	5	8	16	13	9
Body emaciated		0		3	7	19	41	22	22	30	60	52	35
Dropsy,	present,	10	100	35	80	30	65	75	75	13	26	88	59
	absent or not stated,	0		9	20.5	16	35	25	25	37	74	62	41
Renal cysts,	present,	0		11	25	20	44	31	31	20	40	51	34
	absent,	10	100	33	75	26	56	69	69	30	60	99	66
Hypertrophy of heart,	left ventricle,	0		12	27.5	20	44	32	32	33	66	100	67
	general,	1	10	14	32	7	15	22	22	13	26		
	very slight, or absent,	9	90	18	41	19	41	46	46	4	8	50	33
Hypertrophy with valvular disease,	left ventricle,	0		3	7	3	7	6	6	14	28	42	28
	general,	0		7	16	5	11	12	12	10	20		
Hypertrophy without valvular disease,	left ventricle,	0		8	18	20	44	28	28	15	30	57	38
	general	1	10	9	20.5	2	4	12	12	2	4		
Valvular disease without hypertrophy		4	40	4	9	4	8	12	12	4	8	16	11
Heart normal		5	50	14	32	12	26	31	31	3	6	34	23
Arterial changes,	present,	0		12	27.5	29	63	41	41	45	90	86	57
	absent,	10	100	32	73	17	36	59	59	5	10	64	43
Renal arteries involved		0		3	7	4	8	7	7	41	82	48	32
Dilatation of heart,	present,	0		14	32	26	56	40	40	34	68	74	49
	absent, or very slight,	10	100	30	68	20	44	60	60	16	32	76	50
Fatty metamorphosis heart muscle,	present,	0		8	18	15	33	23	23	25	50	48	32
	absent, or not stated.	10	100	36	82	31	67	77	77	25	50	102	68
The same without hypertrophy		0		2	4.5	9	20	11	11	5	10	16	11

DISEASE (EXCLUSIVE OF AMYLOID DISEASE).

SERIES B.

RESULTS OF THE ANALYSIS OF THE AUTOPSY RECORDS OF THE PHILADELPHIA HOSPITAL.

Parenchymatous Nephritis.								Interstitial Nephritis.		Total.		Grand Total. (12 per cent. of all deaths.)	
Acute Bright's.		Large white.		Fatty and contracted.		Total of parenchymatous.		Red granular.					
5		35		35		75		75		150		300	
31 years		39 years		46 years		.....		59 years		.....		.....	
No.	pr. ct.	No.	r. ct.	No.	pr. ct.	No.	pr. ct.	No.	pr. ct.	No.	pr. ct.	No.	pr. ct.
0		9	26	11	31	20	27	30	40	50	33	97	32
2	40	5	14	4	11	11	15	7	9	18	12	45	15
0		0		1	3	1	1.5	5	7	6		20	6.5
2	40	2	6	3	9	7	9	6	8	13	9	22	7.5
0		1	3	2	6	3	4	4	5	7	4.5	35	11.5
0		3	9	2	6	5	7	0		5	3	14	4.5
0		2	6	5	14	7	9	4	5	11	7	19	6
0		2	6	2	6	4	5	5	7	9	6	22	7.5
0		3	9	9	26	12	16	14	19	26	17	78	26
5	100	19	54	13	37	37	49.5	22	29	59	39.5	147	49
0		16	46	22	63	38	51	53	71	91	61	153	51
0		4	11	10	29	14	19	25	33	39	26	90	30
5	100	31	89	25	71	61	81	50	67	111	74	210	70
1	20	4	11	9	26	14	19	23	31	87	58	187	62
0		15	43	13	37	28	37	22	29				
4	80	16	46	13	37	33	44	30	40	63	42	113	38
0		12	34	11	31	23	31	29	39	52	35	94	31.5
1	20	9	26	9	26	19	25	17	23	36	24	93	31
1	20	3	9	3	9	7	9	12	16	19	13	35	11.5
3	60	11	31	12	34	26	35	17	23	43	29	77	26
1	20	9	26	13	37	23	31	48	64	71	47	157	52
4	80	26	7	22	63	52	69	27	36	79	53	143	48
.....	.....	.....		.....		.....		.....		.....		.....	
1	20	9	26	14	40	24	32	27	36	51	34	125	41.5
4	80	26	7	21	60	51	68	48	64	99	66	175	58
1	20	5	14	8	23	14	19	17	23	31	20.5	79	26
4	80	30	86	27	77	61	81	58	77	119	79	221	73.5
1	20	2	6	3	9	6	8	14	19	20	13	36	12

per cent. of the cases,[1] and in the interstitial nephritis in 92 per cent.

Series B. Hospital cases.—Hypertrophy of heart in connection with parenchymatous nephritis occurred in 56 per cent. of all cases, and in the interstitial nephritis in 60 per cent.[2]

Relation to Valvular Disease.

The relation of valvular disease to the two forms of Bright's disease (the parenchymatous and the interstitial) appears to be an indefinite one.

Valvular disease *without* hypertrophy proves to be nearly equally distributed between the parenchymatous and interstitial, occurring in the former in 12 per cent. and in the latter in 13 per cent.

In the chronic interstitial nephritis hypertrophy of the heart without valvular disease was met with in 27 per cent. of all cases, while in the parenchymatous form it was 34.5 per cent.

Hypertrophy of the heart *with valvular disease* coexisted with chronic interstitial nephritis in 42 per cent., or nearly twice as frequent as in the parenchymatous forms in which it was 23 per cent. (occurring with equal frequency in the large, white, and fatty and contracted kidney).

The *degree* of hypertrophy appears also to be influenced by valvular disease, and still more by pericarditis, as the following results will show:

	Cases.	Average weight of heart
Hypertrophy without valvular disease . .	93	14 ounces.
Hypertrophy with valvular disease . .	94	17 "
Hypertrophy with pericarditis . . .	22	18 "

The duration of the disease and probably the age of the patient are evidently correlative with the degree of the hypertrophy.

[1] The cases of parenchymatous nephritis recorded in the tables, it will be remembered, all belong to the *chronic* form save fifteen cases which are *acute* Bright's disease. These few cases appear, moreover, nearly in equal proportion in the two series, so that a comparison may be fairly made.

[2] There were five cases among the Hospital records of red granular kidney in which the cause of death was designated *senility*. As there were many aged persons among the autopsy material of this series, I fear that some more cases of senile atrophy of the kidneys with absence of hypertrophy of the heart, have crept into these records. This would explain the discrepancy in the statistical results, viz., 60 per cent. of hypertrophy in the Hospital cases to 92 per cent. in my own cases (in red granular kidney).

The average weight of the hypertrophied heart appears from my tables to be as follows in the different forms of Bright's disease:

	Average weight.
In acute Bright's	10 ounces.
In large white kidney	15 "
In fatty and contracted kidney	14 "
In red granular kidney	17 "

Relation of the weight of the body to the weight of the heart.—That the former has a great influence upon the apparent degree of the hypertrophy of the heart, may be gleaned of the table that I submit below, in which the important factor, the weight of the body, expressed in pounds, is considered side by side with the weight of the hypertrophied heart.

TABLE SHOWING RELATION OF WEIGHT OF HEART TO THAT OF BODY.

Weight of the heart as found.	Large white kidneys, including 10 cases acute Bright's disease. (54 cases.)		Fatty and contracted kidneys. (46 cases.)		Red granular kidneys. (50 cases.)	
	Number of cases observed.	Average weight of the bodies.	Number of cases observed.	Average weight of the bodies.	Number of cases observed.	Average weight of the bodies.
Below 10 ounces . . .	13	132	3	120	1	190
10–11 " . . .	5	128	7	130	2	155
11–12 " . . .	2	134	2	135	2	110
12–13 " . . .	6	148	4	130	3	130
13–14 " . . .	5	152	4	134	4	120
14–15 " . . .	3	138	4	132	...	.....
15–16 " . . .	1	145	5	130	6	143
16–17 " . . .	3	157	2	140	7	122
17–18 " . . .	...	.....	3	146	5	135
18–19 " . . .	4	151	2	142	...	.....
19–20 " . . .	3	150	1	130	4	138
20–25 " . . .	9	150	7	152	11	142
25–30 " . . .	...	.....	2	160	5	163

It will be seen from this that advanced degrees of hypertrophy, viz., the heart weighing above 15 ounces, occurred as follows:

	Cases.	Per cent.
Acute Bright's and large white kidney—heart above 15 ounces	20	37.5
Fatty and contracted kidney " " " " .	22	48
Red granular kidney " " " " .	38	76

Where there were large hearts, as a rule, valvular disease coexisted, especially when associated with the red granular kidney. Also, with

few exceptions, *the largest hearts corresponded more or less with the largest sized bodies.*

Microscopy of the hypertrophied cardiac muscle.—There are two points of interest, that I will but briefly refer to.

1. Cardiac hypertrophy depends upon simple increase in the bulk of the muscular fibres, viz., a simple, true hypertrophy and not upon any hyperplasia (increase in number) of the elements. Each individual muscular fibre in the hypertrophied heart shows by accurate micrometry to be up to twice and three times thicker and longer than the normal muscular fibre of the heart, and it is, therefore, not surprising that the latter should become twice and three times enlarged.

The hyperplasia of the connective tissue, though quite marked in many specimens, is not an important factor in adding to the bulk or weight of the heart.

2. Necrotic change of the muscular fibres was occasionally observed in some of the largest hearts, especially in limited areas. Yet in many instances this proved to be due to cadaveric change, which I need not explain at this place. I refer to this only because in some instances it may be mistaken for true ante-mortem fatty metamorphosis of the cardiac muscle.

Fatty Metamorphosis of Heart.

Fatty metamorphosis of the heart in the 300 cases of Bright's disease tabulated in this paper, was found to be present in only 26 per cent.; it being absent in 74 per cent.

The distribution of *fatty metamorphosis* of the *hypertrophied cardiac wall* in the several forms of Bright's disease (see tables of my own cases—coroner's and private) proved to be as follows:

Series A—Coroner's and Private Cases.

	Cases.	Per cent.
In the large white kidney	8	18
In the fatty and contracted kidney	15	33
In the red granular kidney	25	50
Fatty metamorphosis, absent or not stated	102	68
Fatty metamorphosis, without hypertrophy	16	11
Total of fatty metamorphosis	48	32

Series B—Philadelphia Hospital Cases.

	Cases.	Per cent.
In acute Bright's disease	1	20
In the large white kidney	5	14
In the fatty contracted kidney	8	23
In the red granular kidney	17	23
Fatty metamorphosis, absent or not stated	119	79
Fatty metamorphosis, without hypertrophy	20	13

Grand Total.

	Cases.	Per cent.
Fatty metamorphosis, present	79	26
Fatty metamorphosis, absent	221	74

While it appears that fatty metamorphosis of the heart muscle coexists more frequently with the red granular kidney, I found that in many of these cases the necrotic change of the muscle was but slight, whereas in conjunction with the fatty and contracted kidney and in some non-hypertrophied hearts it was decidedly more pronounced. The typical *brown atrophy* of the heart occurred in my cases more commonly in the fatty and contracted kidney, at advanced age and coincident with atheroma of the coronary arteries. The pigmentation around the nuclei of the muscle is also most conspicuous in these cases.

Fatty metamorphosis whenever met with was fairly indicated by the dilatation of the cardiac walls and distinct yellow or brownish striations beneath the endocardium and particularly in the *columnæ carneæ;* occurring with equal frequency in the right and left chambers.

The method adopted for microscopical examination was an easy one and the best, viz., teasing in salt water or weak caustic soda solution; nearly every suspicious heart of Series A was examined while fresh, with the results stated in the records. Fatty infiltration and cirrhoris of the interstitial tissue of the cardiac walls were met with in six cases, combined with fatty metamorphosis.

Arterial Changes.

Atheroma of the aorta and some of the larger vessels was observed as follows:

Series A—Coroner's and Private Cases.

	Cases.	Per cent.
In the large white kidney	12	27.5
In the fatty and contracted kidney	29	63
In the red granular kidney	45	90

Series B—Hospital Cases.

	Cases.	Per cent.
In the large white kidney (including one of acute Bright's disease)	10	23
In the fatty and contracted kidney	13	37
In the red granular kidney	48	64
Total in both series	157	52

Endarteritis and periarteritis of the *renal vessels* were studied only in Series A, and showed:

	Cases.	Per cent.
In the large white kidney	3	7
In the fatty and contracted kidney	4	8
In the red granular kidney	41	82

It should be further noted that whereas the first two of these kidney lesions revealed but slight arterial changes, the red granular kidney showed them well pronounced.

Arterial changes, it is seen, come prominently into consideration only in one form of Bright's disease, viz., the red granular kidney, forming only a small portion of the total histological picture of it. It is not my object in the present paper to go into the consideration of this question. I may state, however, that Gull and Sutton in their excellent original work, "On the Pathology of the morbid state commonly called Bright's Disease," (vide *Med.-Chir. Trans.*, vol. lv. p. 273), appear to refer exclusively to the primarily contracted kidney when they brought forward their famous "Arterio-capillary Fibrosis." Some of the later writers on this subject, however, erroneously attribute *all* forms of Bright's disease to primary vascular changes.

Histological studies in this direction are being conducted, and have been for some time past, in my laboratory by several gentlemen. The results of these investigations, I believe, will prove interesting when published.

Complications.

The prominent complications and concurrent affections other than those already given in my tables, some of which coöperated in the immediate cause of death, are distributed in the 300 cases of Bright's disease recorded as follows:

Hydrothorax 53, pleurisy 40, emphysema 32, peritonitis 21, syphilis 27, alcoholism 18, puerperal diseases 14, tuberculosis 13, meningitis 13, septicæmia 12, cirrhosis of liver 11, bronchitis 10,

ether narcosis and surgical operation 9, erysipelas 8, gastric cancer 8, aneurism 7, senility 5, cancer of various parts 4, gastric ulcer 4, typhoid fever 3, gangrene 2, scarlatina 2, burns 1, etc. Often two or more of these lesions coexisted.

The *average weight of the kidneys* in the various forms of Bright's disease is of interest and is as follows (in ounces):

	Right.	Left.
Acute Bright's disease	7.65	8.12
Large white kidney	6.91	7.87
Fatty and contracted kidney	4.74	4.86
Red granular kidney	3.13	3.43
General average of	5.61	6.07

MORTALITY OR DURATION OF LIFE IN BRIGHT'S DISEASE AS SEEN FROM THE 300 CASES TABULATED.

SERIES A.—PRIVATE AND CORONER'S CASES.

	10–20 yrs.	20–30 yrs.	30–40 yrs.	40–50 yrs.	50–60 yrs.	60–70 yrs.	Over 70 years.
Acute Bright's disease,	3	2	3	2	0	0	0
Large white kidney,	4	15	17	6	1	1	0
Fatty and contracted kidney,	0	4	2	14	12	3	1
Red granular kidney,	1	4	5	5	16	15	4

SERIES B.—PHILADELPHIA HOSPITAL CASES.

Acute Bright's disease and large white kidney,	4	6	12	7	5	1	1
Fatty and contracted kidney,	1	1	7	7	7	7	4
Red granular kidney,	0	3	4	16	17	18	17

I admit that as regards many interesting details these studies, as now presented, are deficient. I propose to complete them in the future with such additions as the continuous new supply of material will offer.

The literature on these subjects is very interesting, but I shall not take up space with matters well known to the reader.

APPENDIX.

THE following is the detailed account of 300 cases of Bright's disease, summarized in the first part of this paper, extracted from a total of 2472 consecutive autopsy records.

SERIES A embraces one hundred and fifty cases from my private and coroner's autopsies.

SERIES B a like number of cases from the Philadelphia Hospital autopsies.[1]

SERIES A.—*Results of Personal Observations from Coroner's and Private Autopsies, September* 1, 1888, *to September*, 1889, *inclusive.*

Total number of autopsies (upon adults)	1172
Total number of typical Bright's disease (exclusive of amyloid kidneys)	150

Parenchymatous nephritis, including—	No. of cases.	Chronic interstitial nephritis, including (only)—	No. of cases.
Acute Bright's disease	10	Red granular or cirrhotic kidney, or primarily contracted (atrophic) kidney	50
Large white kidney	44		
Fatty and contracted kidney, or secondary contracted kidney	46		
Total	100	Total	50
Males	58	Males	34
Females	42	Females	16
Average age (male and female)	37	Average age (male and female)	51.80

ACUTE BRIGHT'S DISEASE (10 CASES).

The appearance of the kidneys were in each case of acute Bright's disease nearly alike, viz.: surface smooth, capsule not adherent, cortex widened, color red, etc.

CASE I. October 1, 1888.—Male, age thirty, weight 170 pounds, bodily condition good. Cause of death burns. Kidneys each 9 ounces. Dropsy general. Heart weight 12 ounces. Valvular disease. Mitral verrucose. Hypertrophy none. Dilatation none. Death on fifth day.

CASE II. November 30, 1888.—Female, age seventeen, weight 110 pounds, bodily condition good. Cause of death scarlatina. Kidneys, weight right 7 ounces, left 8 ounces. Heart weight 8½ ounces. Valvular disease none. Hypertrophy none. Dilatation none. Glomerulonephritis. Septic embolic foci.

[1] In the manuscript all these cases were tabulated, but owing to the inconvenience of printing tables, they were transcribed and condensed to their present form. To save space some details had of necessity to be dispensed with.

CASE III. December 30, 1888.—Male, age thirty-three, weight 180 pounds, bodily condition good. Cause of death erysipelas. Kidneys, weight of each 7¾ ounces. Dropsy general. Heart weight 9 ounces. Ulcerative endocarditis. Hypertrophy none. Dilatation general. Infarcts.

CASE IV. February 3, 1889.—Male, age twenty-two, weight 140 pounds, bodily condition good. Cause of death fracture of spine. Kidneys, weight right 6½ ounces, left 7 ounces. Dropsy general. Heart weight 10 ounces. Valvular disease none. Hypertrophy none. Dilatation none.

CASE V. March 10, 1889.—Male, age forty-one, weight 200 pounds, bodily condition good. Cause of death erysipelas. Kidneys, weight right 7 ounces, left 9 ounces. Dropsy general. Heart weight 13 ounces. Ulcerative endocarditis. Hypertrophy and dilatation general. Hydrothorax and ascites.

CASE VI. April 2, 1889.—Male, age fifteen, weight 90 pounds, emaciated. Cause of death purpura hemorrhagica. Kidneys each 7 ounces. Dropsy general. Heart weight 8 ounces. Valvular disease none. Hypertrophy none. Dilatation none. Acute meningitis.

CASE VII. April 23, 1889.—Female, age thirty-three, weight 125 pounds, bodily condition good. Cause of death pneumonia. Kidneys each 9 ounces. Dropsy general. Heart weight 11 ounces. Valvular disease none. Hypertrophy slight. Dilatation general. Hydrothorax and hydropericardium. Septic embolism and infarcts of kidneys and spleen.

CASE VIII. May 1, 1889.—Female, age forty, weight 135 pounds, bodily condition good, anæmic. Cause of death erysipelas. Kidneys, weight right 7½ ounces, left 8 ounces. Dropsy general. Heart weight 12 ounces. Acute endocarditis. Hypertrophy general. Dilatation general.

CASE IX. May 31, 1889.—Female, age twenty, weight 130 pounds, general condition good. Cause of death typhoid fever. Kidneys each 7½ ounces. Dropsy general. Heart weight 8½ ounces. Hypertrophy none. Dilatation none. Hemorrhagic infarct of spleen and kidneys.

CASE X. June 28, 1889.—Male, age eighteen, weight 140 pounds, general condition good. Cause of death typhoid fever. Kidneys, weight right 8¼ ounces, left 9½ ounces. Dropsy general. Heart weight 9 ounces. Valvular disease, acute mitral. Hypertrophy none. Dilatation none. Acute meningitis.

LARGE WHITE KIDNEYS (44 CASES).

Appearance of the kidney in all cases: surface smooth, capsule not adherent (with a few exceptions), cortex widened, pale and mottled, or striated.

CASE I. September 5, 1888.—Female, age twenty-nine, weight 125 pounds, bodily condition good. Cause of death uræmia. Kidneys each 7 ounces; smooth, non-adherent. Cysts none. Dropsy present. Cortex widened, pale. Heart weight 10 ounces. Valvular disease none. Hypertrophy none. Dilatation general. Fatty metamorphosis marked. Change in coronary arteries. Pleurisy. Lungs congested and œdematous.

CASE II. September 9, 1888.—Male, age thirty-five, weight 160 pounds, bodily condition good, anæmic. Cause of death uræmia. Kidneys, weight right 8 ounces, left 9½ ounces; smooth, non-adherent. Cysts none. Dropsy present. Cortex widened, pale. Heart weight 14 ounces. Valvular disease none. Hypertrophy general. Fatty metamorphosis none. Dilatation slight. Hydrothorax, hydropericardium. Œdema of lungs. Hydrothorax.

CASE III. September 9, 1888.—Female, age twenty-two, weight 140 pounds, bodily condition good. Cause of death puerperal eclampsia. Kidneys, weight right 7 ounces, left 6½ ounces; surface smooth, non-adherent. Cortex widened, pale. Cysts none. Dropsy none. Heart weight 9½ ounces. Valvular disease none. Hypertrophy none. Fatty metamorphosis none. Dilatation none. Arterial change none. Cerebral anæmia.

CASE IV. September 10, 1888.—Female, age twenty-four, weight 120 pounds, bodily condition good. Cause of death uræmia. Kidneys, weight right 7 ounces, left 8½ ounces. Capsule slightly adherent. Cortex widened, pale. Cysts none. Dropsy general. Heart weight 10 ounces. Valvular disease none. Hypertrophy none. Fatty metamorphosis none. Dilatation none. Arterial change none.

CASE V. September 10, 1888.—Male, age thirty-four, weight 180 pounds, bodily condition good. Death sudden. Kidneys, weight right 6 ounces, left 9 ounces. Capsule smooth. Cortex enlarged, yellow and red. Cysts none. Dropsy present. Heart weight 24 ounces. Valvular disease none. Hypertrophy general. Fatty metamorphosis prominent. Dilatation general. Arterial change none. Cardiac muscle highly fatty. Emphysema and hydrothorax.

CASE VI. September 18, 1888.—Male, age twenty-five, weight 170 pounds, bodily condition good. Cause of death pneumonia. Kidneys, weight right 7 ounces, left 8¼ ounces. Capsule smooth. Cortex widened, pale and mottled. Cyst in left kidney. Dropsy (?). Heart weight 12 ounces. Valvular disease none. Hypertrophy none. Fatty metamorphosis none. Dilatation slight. Arterial change none. Acute pleurisy.

CASE VII. September 21, 1888.—Male, age twenty-seven, weight 145 pounds, bodily condition good. Cause of death heart failure. Kidneys, weight right 5½ ounces, left 9 ounces, surface lobulated, not adherent. Cortex widened, pale and mottled. Cysts none. Dropsy general. Heart weight 15½ ounces. Valvular disease. Aorta, ulcerative endocarditis. Hypertrophy of left ventricle. Fatty metamorphosis none. Dilatation general. Arterial change none. Adhesive pericarditis.

CASE VIII. September 22, 1888.—Female, age nineteen, weight 130 pounds, bodily condition good. Cause of death œdema of lungs. Kidneys each 6 ounces. Capsule smooth. Cortex widened, pale. Cystic change none. Dropsy general. Heart weight 8 ounces. Valvular

disease chronic mitral. Hypertrophy none. Fatty metamorphosis none. Dilatation none. Hemorrhagic infarct of spleen and kidney.

CASE IX. September 27, 1888.—Male, age twenty-four, weight 140 pounds, bodily condition good. Cause of death uræmia. Kidneys, weight right 6 ounces, left 7½ ounces. Capsule smooth. Cortex widened, pale. Cysts none. Dropsy general. Heart weight 13 ounces. Valvular disease aortic and mitral. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation right ventricle. Arterial change none. Erysipelas of face.

CASE X. September 28, 1888.—Female, age twenty-six, weight 130 pounds, well nourished. Cause of death œdema of lungs. Kidneys each 6½ ounces. Cysts none. Dropsy general. Heart weight 9 ounces. Valvular disease none. Hypertrophy none. Fatty metamorphosis prominent. Dilatation general. Arterial change none. Broncho-pneumonia. Pleurisy.

CASE XI. October 1, 1888.—Male, age forty, tall, cachectic appearance. Cause of death uræmia. Kidneys, weight right 6 ounces, left 7 ounces. Cysts none. Dropsy of feet and penis. Heart weight 19 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation none. Arterial change, aorta. Pericarditis. Pleurisy. Hydrothorax.

CASE XII. October 5, 1888.—Male, age thirty weight 150 pounds, well nourished. Cause of death œdema of lungs. Kidneys each 5 ounces. Cysts none. Dropsy present. Heart weight 20 ounces. Valvular disease, aortic and mitral, acute. Hypertrophy general. Fatty metamorphosis none. Dilatation none. Arterial change none.

CASE XIII. November 9, 1888.—Female, age forty-three, weight 110 pounds, emaciated. Cause of death œdema of brain. Kidneys, weight right 4½ ounces, left 8 ounces. Cysts large in both. Dropsy none. Heart weight 13 ounces. Valvular disease none. Hypertrophy none. Fatty metamorphosis none. Dilatation general. Arterial change: aorta, coronary, and cerebral. History of syphilis. Chronic peritonitis.

CASE XIV. November 20, 1888.—Male, age nineteen, weight 140 pounds, well nourished. Cause of death œdema of lungs. Kidneys each 9 ounces. Cysts none. Dropsy present. Heart weight 9½ ounces. Valvular disease none. Hypertrophy none. Fatty metamorphosis none. Dilatation none. Arterial change none.

CASE XV. November 25, 1888.—Female, age thirty-five, weight 125 pounds, well nourished. Cause of death septicæmia. Kidneys each 8 ounces. Cysts none. Dropsy general. Heart weight 12 ounces. Valvular disease, aortic and mitral, slight. Hypertrophy general. Fatty metamorphosis (?). Dilatation general. Arterial change none. Abortion. Peritonitis.

CASE XVI. November 26, 1888.—Male, age thirty-one, weight 160 pounds, well nourished. Cause of death heart failure. Kidneys, weight right 9 ounces, left 10 ounces. Cysts large in both. Dropsy. Heart weight 16 ounces. Valvular disease none. Hypertrophy general. Fatty metamorphosis present. Dilatation general. Arterial change none. Hydropericardium, hydrothorax.

CASE XVII. December 5, 1888.—Male, age thirty-three, weight 140 pounds, bodily condition good. Cause of death œdema of lungs. Kidneys, weight right 5½ ounces, left 6 ounces. Cysts none. Dropsy. Heart weight 18 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation none. Arterial change none. Hydropericardium, hydrothorax.

CASE XVIII. December 18, 1888.—Male, age thirty-nine, weight 135 pounds, bodily condition good, anæmic. Cause of death meningitis. Kidneys each 7½ ounces. Cysts in right kidney. Dropsy general. Heart weight 24 ounces. Valvular disease, mitral, acute. Hypertrophy general. Fatty metamorphosis none. Dilatation none. Arterial change of aorta and cerebral. Pericarditis and pleurisy.

CASE XIX. December 19, 1888.—Male, age thirty-one, weight 170 pounds, bodily condition good, anæmic. Cause of death uræmia. Kidneys weight each 8½ ounces. Cysts none. Dropsy general. Heart weight 16½ ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation none. Arterial change none. Hydropericardium and hydrothorax.

CASE XX. December 24, 1888.—Female, age sixty-three, weight 190 pounds, bodily condition good. Cause of death uræmia. Kidneys each 7½ ounces. Cysts none. Dropsy general. Heart weight 22 ounces. Valvular disease none. Hypertrophy general. Fatty metamorphosis none. Dilatation right ventricle. Arterial change, aorta and cerebral.

CASE XXI. January 3, 1889.—Female, age forty-five, weight 115 pounds, emaciated, anæmic. Cause of death heart failure. Kidneys, weight right 6½ ounces, left 8½ ounces. Cysts in left kidney. Dropsy none. Heart weight 14 ounces. Valvular disease none. Hypertrophy general. Fatty metamorphosis prominent. Dilatation general. Arterial change: aorta, coronary, cerebral. Emphysema. Hydrothorax. Gastric ulcer.

CASE XXII. January 6, 1889.—Male, age fifty-four, weight 140 pounds, bodily condition good, anæmic. Cause of death uræmia. Kidneys, weight right 7½ ounces, left 8½ ounces. Cysts in left kidney. Dropsy general. Heart weight 21½ ounces. Valvular disease, aortic calcification. Hypertrophy general. Fatty metamorphosis none. Dilatation general. Arterial change none. Emphysema and œdema of lungs.

CASE XXIII. February 10, 1889.—Male, age thirty-four, very tall, emaciated. Cause of death uræmia. Kidneys each 10 ounces. Cysts in both. Dropsy general. Heart weight 21 ounces. Valvular disease, aortic and mitral. Hypertrophy general. Fatty metamorphosis, slight. Dilatation general. Arterial change: aortic, renal, and cerebral. Hydrothorax and hydropericardium.

CASE XXIV. February 18, 1889.—Male, age twenty-four, weight 140 pounds, well nourished, anæmic. Cause of death œdema of lungs. Kidneys, weight right 8½ ounces, left 7 ounces. Cysts in both. Dropsy general. Heart weight 13 ounces. Valvular disease none. Hypertrophy slight. Fatty metamorphosis some. Dilatation general. Arterial change none. Pleurisy, emphysema.

CASE XXV. March 4, 1889.—Female, age twenty-three, weight 140 pounds, bodily condition good, anæmic. Cause of death puerperal eclampsia. Kidneys each 8 ounces. Cysts none. Dropsy general. Heart weight 10 ounces. No other lesions. Primipara.

CASE XXVI. March 8, 1889.—Male, age sixteen, weight 100 pounds, emaciated, anæmic. Cause of death uræmia. Kidneys each 7½ ounces. Cysts none. Dropsy general. Heart weight 13 ounces. Valvular disease, mitral, acute. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation general. Arterial change none. Acute pleurisy.

CASE XXVII. March 8, 1889.—Male, age thirty, weight 150 pounds, bodily condition good, anæmic. Cause of death œdema of lungs and uræmia. Kidneys, weight right 7 ounces, left 8 ounces. Cysts none. Dropsy general. Heart weight 9½ ounces. No other lesions. Miliary tuberculosis.

CASE XXIX. March 14, 1889.—Male, age thirty-six, weight 200 pounds, bodily condition good, anæmic. Death sudden. Kidneys each 8½ ounces. Cysts none. Dropsy general. Heart weight 20 ounces. Valvular disease, aortic and mitral, chronic. Hypertrophy general. Fatty metamorphosis some. Dilatation general. Arterial change none. Pleurisy, and emphysema and œdema of lungs.

CASE XXX. March 20, 1889.—Female, age thirty-six, weight 120 pounds, bodily condition good, anæmic. Cause of death uræmia. Kidneys each 6½ ounces. Cysts in both. Dropsy general. Heart weight 10 ounces. No other lesion.

CASE XXXI. April 12, 1889.—Female, age thirty-three, weight 140 pounds, bodily condition good. Cause of death puerperal eclampsia. Kidneys, weight right 5 ounces, left 6½ ounces. Cysts none. Dropsy general. Heart weight 14 ounces. Valvular disease none. Hypertrophy left ventricle. No other lesions.

CASE XXXII. April 26, 1889.—Male, forty-two, weight 135 pounds, fat, anæmic. Cause of death uræmia. Kidneys each 6 ounces. Cysts, both full. Dropsy general. Heart weight 18 ounces. Valvular disease none. Hypertrophy general. Fatty metamorphosis quite marked. Dilatation general. Arterial change none. Pericarditis and pleurisy.

CASE XXXIII. May 10, 1889.—Male, age thirty-four, bodily condition good, anæmic. Cause of death œdema of lungs. Kidneys, weight right 8 ounces, left 8½ ounces. Cysts left kidney. Dropsy general. Heart weight 23 ounces. Valvular disease, mitral, chronic. Hypertrophy general. Fatty metamorphosis none. Dilatation none. Arterial change: aorta, coronary, renal.

CASE XXXIV. May 12, 1889.—Male, age twenty-eight, weight 170 pounds, bodily condition good. Cause of death pneumonia. Kidneys, weight right 7 ounces, left 9 ounces. Cysts in left kidney. Dropsy general. Heart weight 19½ ounces. Valvular disease none. Hypertrophy left ventricle. No other lesions. Pericarditis and pleurisy.

CASE XXXV. May 12, 1889.—Male, age forty-three, weight 160 pounds, bodily condition good, anæmic. Cause of death general œdema. Kidneys each 6½ ounces. Cysts none. Dropsy general. Heart weight 22 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty degeneration slight. Dilatation general. Arterial change, aorta. Hydrothorax and hydropericardium.

CASE XXXVI. June 10, 1889.—Female, age twenty-one, weight 135 pounds, bodily condition good. Cause of death puerperal septicæmia. Kidneys, weight right 8½ ounces, left 9½ ounces. Cysts none. Dropsy none. Heart weight 9½ ounces. No other lesions. Peritonitis.

CASE XXXVII. June 11, 1889.—Male, age thirty-seven, medium condition. Cause of death œdema of lungs. Kidneys, weight right 5½ ounces, left 7½ ounces. Cysts none. Dropsy none. Heart weight 16½ ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation none. Arterial change general. History of syphilis.

CASE XXXVIII. June 13, 1889.—Female, age thirty, bodily condition good, medium sized. Cause of death uræmia. Kidneys, weight right 8 ounces, left 8½ ounces. Cysts none. Dropsy general. Heart weight 11 ounces. Erysipelas. No other lesions.

CASE XXXIX. June 27, 1889.—Male, age forty-two, weight 139 pounds, bodily condition good, anæmic. Cause of death pneumonia. Kidneys each 7 ounces. Cysts none. Dropsy general. Heart weight 9 ounces. Dilatation slight. No other lesions. Pericarditis and pleurisy.

CASE XL. June 30, 1889.—Female, age twenty-nine, weight 150 pounds, bodily condition good, anæmic. Cause of death fatal hemorrhage. Kidneys, weight right 7 ounces, left 8½ ounces. Cysts none. Dropsy none. Heart weight 18 ounces. Valvular disease, aortic and mitral. Hypertrophy general. No other lesions. Abortion. Peritonitis.

CASE XLI. July 31, 1889.—Male, age twenty-nine, weight 180 pounds, bodily condition good. Cause of death pneumonia. Kidneys, weight right 9 ounces, left 12 ounces. Cysts none. Dropsy general. Heart weight 12½ ounces. Valvular disease none. Hypertrophy general. Fatty metamorphosis none. Dilatation right ventricle. Arterial change none. Acute pleurisy.

CASE XLII. July 31, 1889.—Female, age twenty-three, weight 110 pounds, well nourished. Cause of death puerperal septicæmia. Kidneys each 7 ounces. Cysts none. Dropsy general. Heart weight 8½ ounces. No other lesions. Peritonitis. Puerperal convulsions.

CASE XLIII. August 22, 1889.—Male, age twenty-seven, height 6 feet, well nourished. Cause of death pneumonia. Kidneys each 10 ounces. Cysts none. Dropsy general. Heart weight 13 ounces. No other changes. Escaped drowning week previous to death.

CASE XLIV. August 22, 1889.—Male, age thirty-four, weight 180 pounds, bodily condition good. Death sudden. Kidneys, weight right 8 ounces, left 9 ounces. Cysts none. Dropsy general. Heart weight 18 ounces. Valvular disease, chronic aortic. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation general. Arterial change, aortic. Pericarditis. Hydrothorax.

FATTY AND CONTRACTED KIDNEY (46 CASES).

Appearance of kidneys in all cases: surface lobulated or granular, capsule adherent, or adherent in places, cortex atrophied, pale or yellowish, or striated.

CASE I. October 3, 1888.—Male, age thirty-eight, well nourished, medium size. Cause of death uræmia. Kidneys each 5 ounces. Cysts in both. Dropsy lower extremity. Heart weight 16½ ounces. Valvular disease none. Hypertrophy left ventricle. No other lesions. Pericarditis.

CASE II. October 20, 1888.—Male, age thirty-seven, large, bodily condition good. Cause of death uræmia. Kidneys each 4½ ounces. Cysts in both. Dropsy lower extremities. Heart weight 24 ounces. Valvular disease, aortic and mitral. Hypertrophy general. Fatty metamorphosis none. Dilatation general. Arterial change, aortic. Emphysema.

CASE III. November 1, 1888.—Male, age thirty-eight, bodily condition good, medium size. Cause of death pneumonia. Kidneys each 5¼ ounces. Cysts none. Dropsy lower extremities. Heart weight 19 ounces. Valvular disease, mitral, acute. Hypertrophy general. No other lesions.

CASE IV. November 2, 1888.—Male, age forty-two, large, anæmic. Cause of death uræmia. Kidneys, weight right 4 ounces, left 4½ ounces. Cysts in both. Dropsy general. Heart weight 22 ounces. Valvular disease, aortic, slight. Hypertrophy left ventricle. No fatty metamorphosis or dilatation. Arterial change general. History of syphilis. Emphysema. Hydrothorax.

CASE V. November 16, 1888.—Female, age thirty-five, weight 120 pounds, large, anæmic. Cause of death œdema of the lungs. Kidneys, weight right 3 ounces, left 4½ ounces. Cysts none. Dropsy general. Heart weight 10 ounces. Valvular disease none. Hypertrophy none. Fatty metamorphosis none. Dilatation general. Arterial change none. Acute peritonitis and ovaritis.

CASE VI. November 19, 1888.—Female, age thirty-three, weight 130 pounds, large, anæmic. Cause of death uræmia. Kidneys, weight right 3½ ounces, left 5½ ounces. Cysts present. Dropsy general. Heart weight 10½ ounces. Valvular disease, aortic, acute. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation right ventricle. Arterial change none.

CASE VII. November 20, 1888.—Female, age fifty, emaciated, tall. Cause of death exhaustion from cancer of uterus. Kidneys, weight right 4½ ounces, left 5 ounces. Cysts large in left kidney. Dropsy none. Heart weight 15½ ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis (?). Dilatation some. Arterial change none.

CASE VIII. November 24, 1888.—Female, age fifty-one, weight 130 pounds, emaciated. Cause of death œdema of lungs. Kidneys each 5 ounces. Cysts in left kidney large. Dropsy present. Heart weight 15 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation left ventricle. Arterial change none. Pleurisy, salpingitis.

CASE IX. December 1, 1888.—Female, age forty-six, bodily condition good, medium size. Cause of death uræmia. Kidneys, weight right 5 ounces, left 4 ounces. Cysts large in both. Dropsy. Heart weight 18 ounces. Valvular disease, slight aortic calcification. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation right ventricle. Arterial change, aortic.

CASE X. January 3, 1889.—Female, age forty-four, small, emaciated. Cause of death cerebral apoplexy. Kidneys, weight right 4 ounces, left 7 ounces. Cysts none. Dropsy slight. Heart weight 12 ounces. Valvular disease none. Hypertrophy none. Fatty metamorphosis well marked. Dilatation general. Arterial change, aortic, coronary, and cerebral. History of syphilis. Bronchitis.

CASE XI. January 4, 1889.—Male, age forty-three, weight 130 pounds, bodily condition good, anæmic. Cause of death uræmia. Kidneys, weight right 4½ ounces, left 5 ounces. Cysts none. Dropsy lower extremities. Heart weight 14 ounces. Valvular disease, chronic aortic. Hypertrophy left ventricle. Fatty metamorphosis slight. Dilatation general. Arterial change general. Pericarditis. Pleurisy chronic.

CASE XII. January 6, 1889.—Male, age twenty-eight, weight 140 pounds, bodily condition good. Cause of death uræmia. Kidneys each 4¼ ounces. Cysts none. Dropsy general. Heart weight 11½ ounces. No other lesions. Surgical operation.

CASE XIII. January 10, 1889.—Female, age fifty-two, weight 170 pounds, bodily condition good. Cause of death cerebral apoplexy. Kidneys, weight right 5 ounces, left 6 ounces. Cysts none. Dropsy none. Heart weight 21 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation none. Arterial change, aortic and cerebral. Pericarditis. Pleurisy and cirrhosis of liver.

CASE XIV. January 14, 1889.—Male, age forty-four, large, bodily condition good. Cause of death uræmia. Kidneys each 6¼ ounces. Cysts in both, large. Dropsy. Heart weight 21 ounces. Valvular disease, mitral, chronic. Hypertrophy general. Fatty metamorphosis none. Dilatation general. Arterial change, aortic. Emphysema and bronchitis.

CASE XV. February 4, 1889.—Female, age fifty-two, weight 130 pounds, emaciated, anæmic. Cause of death uræmia. Kidneys, weight right 5 ounces, left 6 ounces. Cysts large in both. Dropsy none. Heart weight 10 ounces. Valvular disease none. Hypertrophy none. Fatty metamorphosis. Brown atrophy. Dilatation general. Arterial change: aortic, coronary, and cerebral. Pleurisy, chronic, and emphysema.

CASE XVI. February 24, 1889.—Male, age forty-five, weight 135 pounds, emaciated, anæmic. Cause of death cerebral apoplexy. Kidneys each 5 ounces. Cysts large in both. Dropsy general. Heart weight 16 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation slight. Arterial changes (?). Hydropericardium, hydrothorax.

CASE XVII. February 25, 1889.—Female, age thirty-nine, weight 140 pounds, bodily condition good, anæmic. Cause of death œdema of the lungs. Kidneys each 4½ ounces. Cysts present. Dropsy lower extremities. Heart weight 13 ounces. Valvular disease none. Hypertrophy general. Fatty metamorphosis slight. Dilatation general. Arterial change, coronary. Peritonitis. Meningitis.

CASE XVIII. February 26, 1889.—Female, age twenty-four, weight 130 pounds, emaciated. Cause of death uræmia (?) and septicæmia. Kidneys, weight right 5½ ounces, left 6½ ounces. Cysts none. Dropsy none. Heart weight 10 ounces. No other lesions. Puerperal hemorrhages. Phthisis.

CASE XIX. February 26, 1889.—Male, age thirty, weight 180 pounds, bodily condition good. Cause of death heart failure. Kidneys each 5¼ ounces. Cysts none. Dropsy general. Heart weight 22 ounces. Valvular disease none. Hypertrophy general. Fatty metamorphosis (?). Dilatation general. Arterial change none. Adhesive pericarditis.

CASE XX. March 5, 1889.—Male, age sixty-two, weight 130 pounds, bodily condition good. Cause of death ether. Kidneys each 4 ounces. Cysts none. Dropsy none. Heart weight 12 ounces. Valvular disease, mitral. Hypertrophy none. Fatty metamorphosis, brown atrophy. Dilatation general. Arterial change: aortic, coronary, and cerebral. Emphysema.

CASE XXI. March 9, 1889.—Male, age sixty, weight 155 pounds, anæmic. Cause of death cerebral apoplexy. Kidneys each 5 ounces. Cysts numerous in both. Dropsy none. Heart weight 17½ ounces. Valvular disease, aortic calcification. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation general. Arterial change: aortic, coronary, and cerebral. Pleurisy, œdema of the lungs. Hydrothorax.

CASE XXII. March 10, 1889.—Male, aged fifty-one, small, emaciated. Cause of death cerebral apoplexy. Kidneys, weight right 4½ ounces, left 5¼ ounces. Cysts large in both. Dropsy lower extremities. Heart weight 14 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis (?). Dilatation none. Arterial changes: aortic and cerebral.

CASE XXIII. March 14, 1889.—Female, age fifty, weight 155 pounds, bodily condition good, anæmic. Cause of death uræmia. Kidneys each 4½ ounces. Cysts large in both. Dropsy lower extremities. Heart weight 13 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis some. Dilatation right ventricle. Arterial change: aortic, cerebral, and renal. Hemorrhagic infarcts. Peritonitis.

CASE XXIV. March 24, 1889.—Male, age forty, weight 170 pounds, bodily condition good. Cause of death uræmia. Kidneys, weight right 5 ounces, left 5½ ounces. Cysts present. Dropsy general. Heart weight 30 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation general. Arterial changes none. Adhesive pericarditis. Pleurisy and bronchitis. Gastric ulcer.

CASE XXV. April 1, 1889.—Male, age fifty-four, weight 135 pounds, emaciated. Cause of death cholestæmia. Kidneys, weight right 4 ounces, left 5 ounces. Cysts in both. Dropsy general. Heart weight 10 ounces. Valvular disease none. Hypertrophy none. Fatty metamorphosis some. Dilatation general. Arterial change: aortic, coronary, and cerebral. Jaundice. Cirrhosis and atrophy of liver. Emphysema. Hydrothorax.

CASE XXVI. April 2, 1889.—Male, age fifty-three, weight 140 pounds, emaciated. Cause of death uræmia. Kidneys each 6 ounces. Cysts in both. Dropsy general. Heart weight 12 ounces. Valvular disease, mitral, chronic. Hypertrophy slight, general. Brown atrophy. Dilatation general. Arterial change: aortic, coronary, and cerebral. Cancer of stomach. Emphysema. Hydrothorax.

CASE XXVII. April 7, 1889.—Female, age forty-eight, bodily condition good, medium. Cause of death œdema of lungs. Kidneys each 5¼ ounces. Cysts in both. Dropsy some. Heart weight 11 ounces. Valvular disease none. Hypertrophy none. Fatty metamorphosis present. Dilatation general. Arterial change: aortic, coronary, and cerebral.

CASE XXVIII. May 4, 1889.—Male, age fortyt-hree, small, emaciated, and anæmic. Cause of death uræmia. Kidneys each 4 ounces. Cysts large in right kidney. Dropsy none. Heart weight 21 ounces. Valvular disease none. Hypertrophy left ventricle. No other lesions.

CASE XXIX. May 6, 1889.—Female, age fifty, small, emaciated, and anæmic. Cause of death cerebral apoplexy. Kidneys each 5 ounces. Cysts none. Dropsy none. Heart weight 10 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none (?). Dilatation none (?). Arterial changes: aortic, cerebral, and coronary. Organs not obtained.

CASE XXX. May 16, 1889.—Female, age thirty-nine, weight 110 pounds, small, emaciated. Death sudden. Kidneys each 4¾ ounces. Cysts none. Dropsy present. Heart weight 9 ounces. Valvular disease, mitral, chronic. Hypertrophy none. Fatty metamorphosis prominent. Dilatation general. Arterial change: aortic, coronary, and cerebral. Epithelioma of womb. Peritonitis.

CASE XXXI. June 3, 1889.—Female, age forty-one, weight 121 pounds, small, emaciated. Cause of death pneumonia. Kidneys, weight right 4 ounces, left 4½ ounces. Cysts present.

Dropsy none. Heart weight 8 ounces. Valvular disease, aortic, slight. Hypertrophy none. Fatty metamorphosis none. Dilatation some. Arterial change none.

CASE XXXII. June 24, 1889.—Female, age forty-nine, weight 140 pounds, fair. Death sudden. Kidneys, weight right 3¾ ounces, left 4½ ounces. Cysts in both. Dropsy none. Heart weight 15½ ounces. Valvular disease, mitral, chronic. Hypertrophy general. Fatty metamorphosis (?). Dilatation general. Arterial change: aortic, coronary, and cerebral. Hydrothorax.

CASE XXXIII. June 27, 1889.—Male, age forty-two, six feet two inches in height, emaciated. Cause of death uræmia. Kidneys, weight right 4 ounces, left 4½ ounces. Cysts large in left kidney. Dropsy none. Heart weight 21 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation none. Arterial change: aortic and cerebral. Emphysema. Meningitis. Hydrothorax.

CASE XXXIV. July 1, 1889.—Male, age thirty-nine, bodily condition good, medium size. Cause of death œdema of lungs. Kidneys, weight right 5¼ onnces, left 6 ounces. Cysts none. Dropsy general. Heart weight 17 ounces. Valvular disease none. Hypertrophy left ventricle. No other changes. Hydrothorax, hydropericardium, pleurisy.

CASE XXXV. July 6, 1889.—Male, age thirty, weight 130 pounds, emaciated. Cause of death uræmia. Kidneys, weight right 3½ ounces, left 4½ ounces. Cysts in both. Dropsy present. Heart weight 15 ounces. Valvular disease none. Hypertrophy left ventricle. No other changes. Hydrothorax, pleurisy, and hydropericardium.

CASE XXXVI. July 9, 1889.—Male, age thirty-six, weight 150 pounds, bodily condition good. Cause of death uræmic coma. Kidneys, weight right 4 ounces, left 4½ ounces. Cysts none. Dropsy general. Heart weight 18 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation slight. Arterial change, aortic. Hydrothorax.

CASE XXXVII. July 9, 1889.—Female, age fifty-two, weight 120 pounds, emaciated. Cause of death heart failure. Kidneys, weight right 7 ounces, left 5 ounces. Cysts in right kidney. Dropsy lower extremities. Heart weight 15 ounces. Valvular disease, aortic, chronic. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation right ventricle. Arterial changes: aortic and coronary. Pericarditis.

CASE XXXVIII. July 12, 1889—Male, age thirty-five, weight 179 pounds, bodily condition good. Death sudden. Kidneys each 4½ ounces. Cysts p esent. Dropsy lower extremities. Heart weight 17 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis some. Dilatation left ventricle. Arterial changes: general, slight. Hydropericardium and hydrothorax.

CASE XXXIX. July 26, 1889.—Female, age forty-six, weight 190 pounds, fat. Cause of death pachymeningitis. Kidneys, weight right 6 ounces, left 7 ounces. Cysts none. Dropsy none. Heart weight 15½ ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. No other changes. History of sunstroke.

CASE XL. August 10, 1889.—Female, age forty-six, weight 140 pounds, emaciated. Cause of death uræmia. Kidneys, weight right 5½ ounces, left 6 ounces. Cysts present. Dropsy lower extremities. Heart weight 10 ounces. Valvular disease none. Hypertrophy none. Brown atrophy. Dilatation general. Arterial change: aortic, coronary, and cerebral. Pericarditis, pleurisy. Meningitis. Phthisis.

CASE XLI. August 13, 1889.—Male, age twenty-seven, small. Cause of death uræmia. Kidneys, weight right 4½ ounces, left 5 ounces. Cystic change none. Dropsy lower extremities. Heart weight 14 ounces. Valvular disease, mitral. Hypertrophy general. No other changes. Pericarditis, pleurisy.

CASE XLII. August 24, 1889.—Male, fifty-six, medium size. Cause of death cerebral apoplexy. Kidneys each 4½ ounces. Large cyst in left kidney. Dropsy lower extremities. Heart weight 13 ounces. Valvular disease, aortic calcification. Hypertrophy slight. Fatty metamorphosis (?). Dilatation left ventricle. Arterial change aortic. Pericarditis, pleurisy, meningitis.

CASE XLIII. August 26, 1889.—Female, age twenty-three, weight 139 pounds, bodily condition good. Cause of death puerperal eclampsia. Kidneys each 5 ounces. Cysts none. Dropsy general. Heart weight 9 ounces. Dilatation general. No other changes.

CASE XLIV. August 29, 1889.—Male, age fifty, weight 150 pounds, emaciated. Found dead in bed. Kidneys, weight right 4½ ounces, left 3¼ ounces. Cysts large in right kidney. Dropsy none. Heart weight 16 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis (?). Dilatation none. Arterial change: aortic and cerebral. Œdema of brain.

CASE XLV. August 31, 1889.—Male, age seventy-four, medium size. Cause of death heart failure. Kidneys each 4½ ounces. Cysts in both. Dropsy none. Heart weight 14 ounces. Valvular disease, aortic, slight. Hypertrophy general. Brown atrophy. Dilatation general. Arterial change: coronary and cerebral.

CASE XLVI. August 31, 1889.—Female, age sixty-five, tall and lean. Cause of death hemorrhage and pachymeningitis. Kidneys each 4 ounces. Cysts present. Dropsy general. Heart weight 12 ounces. Valvular disease, aortic, slight. Hypertrophy slight. Fatty metamorphosis some. Dilatation general. Arterial change: aortic, coronary, and cerebral.

Red Granular or Primary Contracted Kidney.

Appearance of the kidneys in nearly all cases alike, viz.: capsule adherent, surface granular, red or grayish-brown, cortex atrophied, etc.

Case I. September 2, 1888.—Female, age sixty-five, weight 130 pounds, bodily condition good. Cause of death cerebral apoplexy. Kidneys each 3 ounces. Cysts minute. Dropsy none. Heart weight 12½ ounces. Valvular disease, senile calcification. Hypertrophy general. Brown atrophy. Dilatation general. Arterial change: coronary, cerebral, and renal. Atrophy of liver. Fibroid of uterus.

Case II. September 6, 1888.—Male, age sixty, weight 130 pounds, emaciated. Death sudden. Kidneys, weight right 3½ ounces, left 3¾ ounces. Cysts minute. Dropsy none. Heart weight 12 ounces. Valvular disease none. Hypertrophy general. Fatty metamorphosis present. Dilatation general. Arterial change same as last. Emphysema.

Case III. September 10, 1888.—Male, thirty-four, weight 140 pounds, emaciated. Cause of death meningitis. Kidneys weight right 2½ ounces, left 3¼ ounces. Cysts minute. Dropsy none. Heart weight 28½ ounces. Valvular disease, aortic. Hypertrophy left ventricle. Fatty metamorphosis present. Dilatation right side. Arterial change: aortic, coronary, cerebral, and renal. Cirrhosis of liver. Hydrothorax. History of syphilis.

Case IV. September 20, 1888.—Female, age twenty-one, small, anæmic. Cause of death uræmia. Kidneys, weight right 3 ounces, left 2½ ounces. Cysts none. Dropsy none. Heart weight 16 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation slight. Arterial changes general. History of syphilis.

Case V. September 28, 1888.—Male, age fifty-four, weight 150 pounds, anæmic, muscular. Cause of death uræmia. Kidneys each 3¼ ounces. Cysts in right kidney. Dropsy present. Heart weight 22 ounces. Valvular disease, aortic calcification. Hypertrophy left ventricle. Fatty metamorphosis present. Dilatation left side. Arterial change: aortic, renal, and coronary. Chronic pleurisy. Aneurism, aorta.

Case VI. October 16, 1888.—Male, age twenty-four, weight 150 pounds, muscular. Cause of death œdema of lungs. Kidneys, weight right 2¼ ounces, left 3½ ounces. Cysts none. Dropsy none. Heart weight 15¼ ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation right side. Arterial change slight, general. Rheumatism in family. Pericarditis. Cirrhosis of liver. Emphysema. Pleurisy.

Case VII. October 17, 1888.—Male, age fifty-seven, weight 130 pounds, emaciated. Cause of death œdema of lungs. Kidneys each 3¼ ounces. Cysts none. Dropsy none. Heart weight 16 ounces. Valvular disease, aortic calcification. Hypertrophy left ventricle. Fatty metamorphosis present. Dilatation right side. Arterial change, coronary. Emphysema and pericarditis. Pleurisy.

Case VIII. October 25, 1888.—Male, age sixty-four, weight 140 pounds, emaciated. Cause of death uræmic convulsions. Kidneys each 2¼ ounces. Cysts minute. Dropsy none. Heart weight 20 ounces. Valvular disease none. Hypertrophy general. Fatty metamorphosis none Dilatation general. Arterial change: aortic, renal, and coronary. Emphysema, pleurisy.

Case IX. October 28, 1888.—Male, age twenty-eight, weight 135 pounds, emaciated. Cause of death uræmia. Kidneys each 2½ ounces. Cysts none. Dropsy slight. Heart weight 22 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis marked. Dilatation general. Arterial change general. Cystitis and stricture.

Case X. October 29, 1888.—Male, age forty-five, weight 150 pounds, fairly nourished. Cause of death cerebral apoplexy. Kidneys, weight right 2½ ounces, left 3¼ ounces. Cysts none. Dropsy none. Heart weight 19 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation none. Arterial change general. Aneurism, aorta.

Case XI. November 1, 1888.—Male, age sixty, weight 120 pounds, emaciated. Cause of death œdema of lungs. Kidneys, weight right 3 ounces, left 3½ ounces. Cysts small and numerous. Dropsy present. Heart weight 20 ounces. Valvular disease, aortic calcification. Hypertrophy left ventricle. Fatty metamorphosis general. Dilatation right side. Arterial change general. Chronic pleurisy and pericarditis.

Case XII. November 4, 1888.—Male, age sixty, weight 130 pounds, emaciated. Cause of death œdema of lungs. Kidneys each 3¼ ounces. Cysts none. Dropsy present. Heart weight 17 ounces. Valvular disease, aortic calcification. Hypertrophy left ventricle. Fatty metamorphosis present. Dilatation general and great. Arterial change general. Heart-muscle very fatty. Emphysema. Hydrothorax.

Case XIII. November 8, 1888.—Male, age fifty-one, weight 135 pounds, emaciated. Death sudden. Kidneys, weight right 4 ounces, left 5 ounces. Cysts none. Dropsy none. Heart weight 25 ounces. Valvular disease, mitral, chronic. Hypertrophy general. Fatty metamorphosis none. Dilatation general. Arterial change, aortic and renal. Chronic pleurisy. Bronchiectasis. History of syphilis.

Case XIV. November 9, 1888.—Female, age seventy-three, weight 130 pounds, emaciated. Cause of death cerebral apoplexy. Kidneys each 3¼ ounces. Cysts none. Dropsy none. Heart weight 15½ ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation none. Arterial change aortic, general. Cirrhosis of liver. Emphysema. chronic pleurisy. Cirrhosis of liver.

CASE XV. November 9, 1888.—Female, age forty-six, weight 140 pounds, emaciated. Cause of death œdema of lungs, uræmia. Kidneys each 3½ ounces. Cysts and dropsy present. Heart weight 22 ounces. Valvular disease, mitral. Hypertrophy general. Fatty metamorphosis none. Dilatation none. Arterial change, aortic and renal. Chronic pericarditis and pleurisy.

CASE XVI. November 15, 1888.—Female, age fifty-nine, weight 110 pounds, much emaciated. Death sudden. Kidneys each 2½ ounces. Cysts none. Dropsy none. Heart weight 13 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation none. Arterial change general but slight. Pachymeningitis.

CASE XVII. November 19, 1888.—Male, age sixty-five, weight 135 pounds, emaciated. Cause of death uræmic convulsions. Kidneys, weight right 2 ounces, left 4 ounces. Cysts present. Dropsy none. Heart weight 16½ ounces. Valvular disease, aortic stenosis, calcified. Hypertrophy left ventricle. Fatty metamorphosis present. Dilatation general. Arterial change general. History of syphilis.

CASE XVIII. November 22, 1888.—Female, age sixty-six, weight 120 pounds, emaciated. Cause of death uræmia. Kidneys each 4 ounces. Cysts none. Dropsy of feet. Heart weight 17 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation left side. Arterial change general. History of syphilis.

CASE XIX. November 30, 1888.—Male, age sixty, weight 180 pounds, bodily condition good. Cause of death œdema of brain and lungs. Kidneys each 4¼ ounces. Cysts none. Dropsy present. Heart weight 24 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis some. Dilatation general. Arterial change general. Chronic pericarditis and pleurisy.

CASE XX. December 2, 1888.—Male, age thirty-three, weight 150 pounds, well nourished. Anæmia and history of malaria. Cause of death œdema of lungs. Kidneys each 4 ounces. Cyst in left kidney. Dropsy none. Heart weight 17½ ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation general. Arterial change general. Rheumatism, lead colic.

CASE XXI. December 8, 1888.—Male, age sixty-six, weight 120 pounds, well nourished. Cause of death cerebral apoplexy. Kidneys, weight right 3½ ounces, left 3¾ ounces. Cysts present. Dropsy none. Heart weight 25 ounces. Valvular disease, aortic and mitral. Hypertrophy general. Fatty metamorphosis none. Dilatation general. Arterial change general. Hydropericardium, hydrothorax, emphysema. Gastric cancer.

CASE XXII. December 10, 1888.—Female, age thirty-two, weight 100 pounds, emaciated, muscular. Cause of death uræmia. Kidneys each 2¼ ounces. Cysts none. Dropsy present. Heart weight 17 ounces. Valvular disease, aortic, acute. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation none. Arterial change slight but general. History of syphilis.

CASE XXIII. December 13, 1888.—Female, age forty-six, weight 155 pounds, bodily condition good. Cause of death uræmia. Kidneys, weight right 3 ounces, left 4 ounces. Cysts none. Dropsy present. Heart weight 17½ ounces. Valvular disease, aortic and mitral slight. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation general. Arterial change general. Hydropericardium and hydrothorax.

CASE XXIV. December 29, 1888.—Male, age fifty-eight, weight 155 pounds, bodily condition good. Death sudden. Kidneys, weight right 2¾ ounces, left 3½ ounces. Cysts minute. Dropsy none. Heart weight 26 ounces. Valvular disease, aortic calcification. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation general. Arterial change general. Hydronephrosis. Hydrothorax.

CASE XXV. January 5, 1889.—Male. age seventy, weight 150 pounds, emaciated. Death sudden. Kidneys, weight right 2½ ounces, left 2¾ ounces. Cysts none. Dropsy none. Heart weight 15 ounces. Valvular disease, aortic and mitral calcification. Hypertrophy general. Brown atrophy. Dilatation general. Arterial change general. Emphysema. History of syphilis.

CASE XXVI. January 24, 1889.—Female, age forty-nine, weight 135 pounds, emaciated. Cause of death uræmia. Kidneys each 2½ ounces. Cysts none. Dropsy none. Heart weight 16 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation none. Arterial change aortic and renal. Gastric ulcer.

CASE XXVII. January 30, 1889.—Female, age nineteen, weight 120 pounds, small. Cause of death uræmia. Kidneys, weight right 4 ounces, left 5 ounces. Cysts none. Dropsy none. Heart weight 13 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation none. Arterial change general. History of syphilis.

CASE XXVIII. January 31, 1889.—Male, age fifty-two, weight 160 pounds, bodily condition good. Cause of death œdema of lungs. Kidneys, weight right 4½ ounces, left 2¼ ounces. Cysts present. Dropsy of extremities. Heart weight 23 ounces. Valvular disease, aortic and mitral, slight. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation general. Arterial change general. Pleurisy and œdema of brain. Aneurism of aorta.

CASE XXIX. February 2, 1889.—Male, age forty-five, weight 140 pounds, bodily condition good. Cause of death meningitis and œdema of brain. Kidneys, weight right 2½ ounces, left 4 ounces. Cysts present. Dropsy of extremities. Heart weight 10 ounces. Arterial change general. No other lesions. Syphilis and pleurisy. Hydrothorax.

CASE XXX. March 10, 1888.—Male. age sixty-five, weight 170 pounds, emaciated. Cause of death heart failure. Kidneys, weight right 1½ ounces, left 3 ounces. Cysts none. Dropsy none. Heart weight 19 ounces. Valvular disease, aortic, chronic. Hypertrophy general. Dilatation general. Fatty metamorphosis pronounced. Arterial change general. Emphysema and pleurisy.

CASE XXXI. April 4, 1889.—Male, age sixty, small and emaciated. Cause of death cerebral apoplexy. Kidneys each 4 ounces. Cysts present. Dropsy none. Heart weight 20 ounces. Valvular disease, aortic, chronic. Hypertrophy left ventricle. Fatty metamorphosis slight. Arterial change, aortic. Dilatation slight. Pericarditis and pleurisy. Emphysema.

CASE XXXII. April 15, 1889.—Male, age sixty-one, well nourished, anæmic, weight 190 pounds. Death sudden. Kidneys each 2¾ ounces. Cysts present. Dropsy present. Heart weight 9 ounces. Valvular disease, mitral, chronic. Hypertrophy none. Brown atrophy. Dilatation general. Arterial change, aortic. History of syphilis.

CASE XXXIII. April 26, 1889.—Male, age fifty-nine, small, emaciated. Cause of death uræmia. Kidneys, weight right 1½ ounces, left 3 ounces. Cysts present. Dropsy slight. Heart weight 19 ounces. Valvular disease, aortic, chronic. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation slight. Arterial change general. Emphysema and pleurisy.

CASE XXXIV. May 3, 1889.—Male, age sixty-five, weight 200 pounds, muscular. Cause of death œdema of lungs. Kidneys, weight right 4 ounces, left 4½ ounces. Cysts present. Dropsy present. Heart weight 13 ounces. Valvular disease, aortic, chronic. Hypertrophy none. Fatty metamorphosis none. Dilatation general. Arterial change (?). Pericarditis and emphysema. Acute alcoholism.

CASE XXXV. May 15, 1889.—Male, age fifty, weight 220 pounds, well nourished. Cause of death uræmia. Kidneys each 2½ ounces. Cysts none. Dropsy present. Heart weight 28 ounces. Valvular disease, aortic, chronic. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation left ventricle. Arterial change general. Cirrhosis of liver. Emphysema.

CASE XXXVI. May 20, 1889.—Male, age sixty-eight, weight 150 pounds, tall, emaciated. Cause of death cerebral apoplexy. Kidneys, weight right 4 ounces, left 5 ounces. Cysts present. Dropsy none. Heart weight 20½ ounces. Valvular disease, aortic and mitral. Hypertrophy general. Fatty metamorphosis none. Dilatation general. Arterial change general.

CASE XXXVII. May 30, 1889.—Female, age fifty-seven, small, emaciated. Death sudden. Kidneys each 4 ounces. Cysts none. Dropsy present. Heart weight 21 ounces. Valvular disease, mitral, slight. Hypertrophy general. Brown atrophy. Dilatation general. Arterial change general. Hydropericardium, hydrothorax. Emphysema.

CASE XXXVIII. May 30, 1889.—Male, age fifty-seven, fair, medium size. Cause of death pneumonia. Kidneys each 3 ounces. Cysts none. Dropsy present. Heart weight 16½ ounces. Valvular disease, aortic calcification. Hypertrophy left ventricle. Fatty metamorphosis (?). Dilatation left ventricle. Arterial changes, aorta (?). Cirrhosis of liver.

CASE XXXIX. June 10, 1889.—Male, age thirty, weight 150 pounds, well nourished. Cause of death œdema of lungs. Kidneys each 3½ ounces. Cysts none. Dropsy lower extremities. Heart weight 15 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation general. Arterial change (?). Syphilitic lesions.

CASE XL. June 18, 1889.—Male, age fifty-eight, weight 150 pounds, tall, emaciated, anæmic. Cause of death *ether*. Kidneys, weight right 4 ounces, left 3½ ounces. Cysts present. Dropsy none. Heart weight 17½ ounces. Valvular disease none. Hypertrophy general. Fatty metamorphosis none. Dilatation slight. Arterial change (?). Pericarditis and pleurisy.

CASE XLI. June 20, 1889.—Female, age fifty-three, weight 130 pounds, well nourished. Death sudden. Kidneys each 3½ ounces. Cysts present. Dropsy none. Heart weight 12 ounces. Valvular disease none. Hypertrophy slight. Fatty metamorphosis (?). Dilatation slight. Arterial changes (?). Gastric cancer.

CASE XLII. June 20, 1889.—Female, age fifty-two, weight 110 pounds, emaciated. Cause of death œdema of lungs. Kidneys each 2¼ ounces. Cysts none. Dropsy none. Heart weight 15 ounces. Valvular disease none. Hypertrophy none. Fatty metamorphosis none. Dilatation general. Arterial changes general. Pericarditis and history of rheumatism.

CASE XLIII. June 30, 1889.—Male, age twenty-six, weight 130 pounds, emaciated. Cause of death uræmia. Kidneys each 2½ ounces. Cysts none. Dropsy none. Heart weight 23 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation general. Arterial change general, slight. History unknown.

CASE XLIV. July 1, 1889.—Male, age fifty-nine, weight 135 pounds, emaciated. Cause of death uræmia. Kidneys each 4 ounces. Cysts none. Dropsy none. Heart weight 16 ounces. Valvular disease none. Hypertrophy general. Fatty metamorphosis none. Dilatation general. Arterial change general. Emphysema, pericarditis, and bronchiectasis.

CASE XLV. July 7, 1889.—Male, age sixty, weight 170 pounds, well nourished. Cause of death œdema of lungs. Kidneys, weight right 4 ounces, left 3½ ounces. Cysts present. Dropsy present. Heart weight 15 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation none. Arterial change, aorta (?). Emphysema and pericarditis. Hydrothorax.

CASE XLVI. July 16, 1889.—Female, age seventy-six, small, emaciated. Cause of death cerebral apoplexy. Kidneys each 4 ounces. Cysts none. Dropsy none. Heart weight 11 ounces. Valvular disease, aortic and mitral, senile. Hypertrophy slight. Fatty metamorphosis slight. Dilatation none. Arterial change general.

CASE XLVII. August 8, 1889.—Male, age fifty-three, weight 130 pounds, emaciated. Cause of death œdema of lungs. Kidneys, weight right 4 ounces, left 4½ ounces. Cysts present. Dropsy present. Heart weight 13 ounces. Valvular disease, aortic, chronic. Hypertrophy slight. Brown atrophy. Dilatation general. Arterial changes general. Emphysema. Syphilis.

CASE XLVIII. August 15, 1889.—Female, age fifty, weight 110 pounds, small, anæmic. Cause of death heart failure. Kidneys each 4½ ounces. Cysts none. Dropsy none. Heart weight 14 ounces. Valvular disease none. Hypertrophy general. Brown atrophy. Dilatation general. Arterial changes general. Liver atrophied, icterus.

CASE XLIX. August 23, 1889.—Male, age thirty-eight, weight 130 pounds, emaciated. Cause of death uræmia. Kidneys each 3 ounces. Cysts none. Dropsy none. Heart weight 12 ounces. Valvular disease none. Hypertrophy left ventricle. Fatty metamorphosis none. Dilatation none. Arterial changes (?). Spleen 12 ounces. History of malaria.

CASE L. August 24, 1889.—Female, age seventy-six, weight 140 pounds, well nourished. Cause of death cerebral apoplexy. Kidneys, weight right 2½ ounces, left 3½ ounces. Cysts none. Dropsy none. Heart weight 10½ ounces. Valvular disease, senile calcification. Hypertrophy none. Brown atrophy. Dilatation general. Arterial change general.

SERIES B.—*Results of the Analysis of the Autopsy Records of the Philadelphia Hospital for Five Years* (1884–1889).

Total number of autopsies	1300
Total number of typical Bright's disease (exclusive of amyloid kidneys)	150

	No. of cases.		No. of cases.
Parenchymatous nephritis, including—		Chronic interstitial nephritis, including only—	
Acute Bright's disease	5	Red granular or cirrhotic kidney, or primarily contracted (atrophic) kidney	75
Large white kidney	35		
Fatty and contracted, or secondary contracted kidney	35		
Total	75	Total	75
Males	47	Males	39
Females	23	Females	36
Average age	43	Average age	59

ACUTE BRIGHT'S DISEASE, OR ACUTE PARENCHYMATOUS NEPHRITIS (5 CASES).

Appearance of kidneys the same as given in the first series.

CASE I. Tyson, June 8, 1885.—Male, age thirty-two. Cause of death pneumonia. Kidneys one-third larger than normal. Dropsy Heart normal size. Fatty metamorphosis. Valvular disease, mitral regurgitation. Dilatation left side. General anasarca.

CASE II. Osler, January 23, 1888.—Male, age forty-four. Cause of death œdema of lungs. Kidneys equally large, swollen. Dropsy. Heart large. Hypertrophy slight. Atheroma posterior coronary artery. General anasarca.

CASE III. Henry, March 23, 1888.—Male, age thirty-three. Cause of death erysipelas. Kidneys 10 ounces each. Dropsy. Heart weight 15 ounces. Hypertrophy left side. General anasarca. Acute pleurisy.

CASE IV. Musser, August 7, 1888.—Male, age thirty-five. Cause of death œdema of lungs. Kidneys much enlarged. Heart normal size. Slight hypertrophy. Aorta dilated.

CASE V. Neff, October 17, 1886.—Male, age fourteen. Cause of death pneumonia. Kidneys much enlarged. Dropsy. Heart normal. Acute hepatitis.

LARGE WHITE KIDNEY (35 CASES).

Appearance of the kidneys the same as given in the first series of cases.

CASE I. Neff, August 1, 1884.—Male, age forty-seven. Death sudden. Kidneys both equal but half larger than normal. Cysts present. Dropsy present. Heart weight 28 ounces. Valvular disease, aortic and mitral insufficiency. Hypertrophy general. Fatty metamorphosis none. Dilatation general. Atheroma none. Chronic endocarditis.

CASE II. Curtin, October 4, 1884.—Male, age forty-four. Death sudden. Kidneys slightly enlarged equally. Cysts present. Heart normal size, but muscle anæmic.

CASE III. Parvin, February 2, 1885.—Female, age eighteen. Cause of death puerperal septicæmia. Kidneys each 9½ ounces. Heart slightly enlarged. Dilatation right side. No other lesion.

CASE IV. Hearn, September 21, 1885.—Female, age thirty-two. Cause of death surgical operation. Heart normal size. Disease of femur.

CASE V. Walker, October 1, 1885.—Female, age twenty-four. Cause of death uræmia. Dropsy. Heart normal.

CASE VI. Tyson, December 29, 1885.—Female, age thirty-one. Cause of death acute endocarditis. Kidneys, weight right 14 ounces, left 13 ounces. Dropsy. Heart enlarged. Valvular disease, aortic and mitral. Hypertrophy left side. Hydrothorax. No other lesions.

CASE VII. Walker, February 13, 1886.—Male, age thirty-nine. Cause of death heart failure. Kidneys enlarged. Dropsy. Heart large. Valvular disease, aortic and mitral insufficiency. Hypertrophy general. Fatty metamorphosis. Dilatation general. Atheroma of aorta. Lung compressed from great hypertrophy of heart.

CASE VIII. Stryker, April 25, 1886 —Female, age twenty. Cause of death uræmic coma. Kidneys each 10 ounces. Dropsy present. Heart weight 11 ounces.

CASE IX. Wilson, May 14, 1886.—Female, age thirty-eight. Cause of death uræmia. Kidneys each one-third above normal. Dropsy general. Heart somewhat enlarged. Hypertrophy slight, general. Atheroma slight in aorta.

CASE X. Tyson, July 8, 1886.—Male, age thirty. Cause of death œdema of lungs. Kidneys much enlarged. Heart normal size.

CASE XI. Mills, October 17, 1886.—Male, age thirty. Cause of death pneumonia. Kidneys each one-third above normal. Heart large. Valvular disease, aortic. Hypertrophy left side. Fatty metamorphosis probably present. Dilatation left side.

CASE XII. Neff, October 27, 1886.—Male, age thirty-nine. Cause of death embolic pneumonia. Kidneys each 11 ounces. Cysts present. Heart weight 23 ounces. Valvular disease, aortic. Hypertrophy general. Dilatation general.

CASE XIII. Osler, December 11, 1886.—Male, age seventy-one. Cause of death meningitis (purulent, basic). Kidneys each 7 ounces. Cysts innumerable. Heart medium size. Valvular disease, mitral and aortic. Brown atrophy. Atheroma, aorta, and places in coronary.

CASE XIV. Neff, January 1, 1887.—Female, age sixteen. Cause of death œdema of lungs. Kidneys much enlarged. Dropsy. Heart normal.

CASE XV. Bruen, April 11, 1887.—Male, age thirty-three. Cause of death œdema of lungs. Kidneys enlarged. Dropsy. Heart weight 32 ounces. Valvular disease, mitral regurgitation. Hypertrophy general. Dilatation general.

CASE XVI. Bruen, June 11, 1887.—Male, age thirty-four. Cause of death œdema of lungs. Kidneys above normal. Dropsy. Heart large. Hypertrophy general.

CASE XVII. Tyson, July 26, 1887.—Male, age seventy. Cause of death congestion of lungs. Kidneys large, unequal. Dropsy. Heart large. Valvular disease, aortic and mitral. Hypertrophy general. Fatty metamorphosis present. Atheroma of aorta and coronary. Large right inguinal hernia.

CASE XVIII. Walker, July 13, 1887.—Male, age twenty-six. Cause of death phthisis. Kidneys each 10 ounces. Heart normal.

CASE XIX. Wilson, July 22, 1887. — Female, age thirty-three. Cause of death uræmia. Kidneys equally enlarged. Heart normal in size. Valvular disease, mitral stenosis.

CASE XX. Musser, August 16, 1887. — Male, age thirty-seven. Cause of death uræmia. Kidneys each 8 ounces. Dropsy. Heart weight 11 ounces. Hypertrophy general. Pericarditis.

CASE XXI. Musser, October 12, 1887.—Male, age thirty-six. Cause of death heart failure. Kidneys equally large. Dropsy. Heart weight 9½ ounces. Hypertrophy left side. Atheroma, aorta.

CASE XXII. Musser, January 23, 1888.—Male, age fifty. Cause of death uræmia. Kidneys equally large. Dropsy. Heart normal size. Hypertrophy left side. Fatty metamorphosis probably present. Dilatation right ventricle.

CASE XXIII. Walker, June 5, 1888.—Male, age fifty-two. Cause of death uræmia. Kidneys equally large. Heart slight hypertrophy. Hydrothorax.

CASE XXIV. Parish, June 22, 1888.—Female, age thirty-two. Cause of death septicæmia. Kidneys, weight right 11½ ounces, left 13 ounces. Miliary septic abscesses. Heart normal. Cystitis, septic abscess.

CASE XXV. Musser, August 7, 1888.—Male, age twenty-seven. Cause of death œdema of lungs. Kidneys each 18 ounces. Heart normal.

CASE XXVI. Dercum, March 3, 1889.—Female, age fifty-seven. Cause of death septicæmia from bedsores. Kidneys equally enlarged. Cysts. Heart normal size. Valvular disease, mitral. Atheroma of aorta and coronary. Hemorrhagic infarct of kidney.

CASE XXVII. Henry, June 15, 1889.—Female, age forty-five. Cause of death cerebellar glioma. Kidneys equally enlarged. Heart weight 12 ounces. Valvular disease, aortic, slight. Hypertrophy present.

CASE XXVIII. Walker, April 20, 1889.—Male, age sixty. Cause of death pneumonia. Kidneys equally enlarged. Heart large. Valvular disease, aortic. Hypertrophy general. Dilatation general.

CASE XXIX. Walker, July 11, 1889.—Male, age forty. Cause of death pericarditis. Kidneys equally enlarged. Heart large. Valvular disease, aortic and mitral. Hypertrophy general. Atheroma of aorta.

CASE XXX. Tyson, July 23, 1889.—Female, age sixty. Cause of death uræmia. Kidneys each 6 ounces. Dropsy. Heart weight 22 ounces. Valvular disease, mitral. Hypertrophy left side. Dilatation left side. Atheroma of aorta.

CASE XXXI. Wilson, July 24, 1889.—Male, age thirty-two. Cause of death uræmia. Kidneys each 6½ ounces. Heart weight 9 ounces. Lungs, chronic phthisis.

CASE XXXII. Tyson, July 24, 1889.—Male, age thirty. Cause of death abdominal tuberculosis. Kidneys each 6½ ounces. Dropsy. Heart weight 9½ ounces. Hypertrophy slight, general. Miliary tuberculosis.

CASE XXXIII. Martin, July 29, 1889.—Male, age forty-four. Cause of death apoplexy, meningitis. Kidneys each 7½ ounces. Heart weight 14 ounces. Valvular disease, aortic and mitral, acute. Hypertrophy general.

CASE XXXIV. Henry, July 31, 1889.—Male, age forty-four. Cause of death acute phthisis. Kidneys each 10 ounces. Heart weight 10 ounces. Hypertrophy general. Slight general atheroma.

CASE XXXV. Curtin, August 10, 1889.—Male, age seventeen. Cause of death typhoid fever. Kidneys each 5½ ounces. Heart weight 11 ounces. Hypertrophy general. Scrofulous.

FATTY AND CONTRACTED KIDNEY (35 CASES).

Appearance of the kidneys the same as in the first series.

CASE I. Tyson, April 3, 1884.—Male, age fifty-five. Cause of death uræmia. Kidneys, weight right 4 ounces, left 4¾ ounces. Large cysts in both. Dropsy. Heart large. Hypertrophy general. Atheroma of aorta. Evidence of subacute attack.

CASE II. Walker, May 3, 1884.—Female, age twenty-two. Cause of death uræmia. Kidneys, weight right 3 ounces, left 5½ ounces. Large cyst in left kidney. Heart normal.

CASE III. Tyson, August 13, 1884.—Female, age forty. Cause of death pyelitis and inanition. Kidneys above normal. Heart normal. Complete prolapsus uteri. Pyelitis.

CASE IV. Neff, August 25, 1884.—Male, age forty. Cause of death œdema of lungs. Kidneys, left very large, right smaller. Dropsy. Heart large. Valvular disease, mitral. Hypertrophy left ventricle. Atheroma of aorta.

CASE V. Curtin, November 3, 1884.—Male, age thirty-eight. Cause of death heart failure. Kidneys equally enlarged. Heart large. Valvular disease, aortic thickening. Hypertrophy slight.

CASE VI. Curtin, January 24, 1885.—Male, age forty-three. Cause of death pneumonia. Kidneys each 5½ ounces. Heart normal.

CASE VII. Tyson, May 11, 1885.—Male, age sixty-eight. Cause of death pulmonary œdema. Kidneys, weight right 4 ounces, left 4½ ounces. Cysts in right kidney. Heart weight 16 ounces. Valvular disease, mitral. Hypertrophy general. Atheroma of aorta.

CASE VIII. Wilson, May 19, 1885.—Male, age fifty-five. Cause of death pneumonia. Kidneys unequally enlarged. Heart normal.

CASE IX. Bruen, August 8, 1885.—Female, age fifty. Cause of death pneumonia. Kidneys above normal, both equal. Cysts. Dropsy. Heart large. Hypertrophy slight, general. Dilatation. Atheroma of aorta.

CASE X. Walker, September 17, 1885.—Male, age nineteen. Cause of death pulmonary œdema. Kidneys below normal, equal. Dropsy. Heart large. Hypertrophy slight. Dilatation right ventricle.

CASE XI. White, November 2, 1885.—Male, age sixty-six. Cause of death septicæmia. Kidneys below normal. Heart normal. Operation for injury of foot.

CASE XII. Wood, December 9, 1885.—Male, age fifty. Cause of death cerebral apoplexy. Kidneys below normal. Heart enlarged. Valvular disease, aortic valves thickened. Hypertrophy right ventricle slight. Atheroma of aorta and cerebral.

CASE XIII. Walker, March 4, 1886.—Male, age forty-five. Cause of death heart failure. Kidneys below normal. Dropsy. Heart weight 28 ounces. Valvular disease, aortic, chiefly endocarditis. Hypertrophy general. Fatty metamorphosis. Dilatation general. Endocarditis and pericarditis, chronic.

CASE XIV. Wood, April 8, 1886.—Female, age sixty-four. Cause of death uræmia. Kidneys below normal. Heart normal size. Fatty metamorphosis. Dilatation slight, general.

CASE XV. Walker, June 19, 1886.—Male, age sixty-one. Cause of death œdema of lungs. Kidneys above normal. Heart enlarged. Fatty metamorphosis. Dilatation general and well marked. Thickness of left ventricle much diminished.

CASE XVI. Osler, December 19, 1886.—Male, age fifty. Cause of death uræmia. Kidneys below normal in size. Cyst with calculus size of a large pea. Heart normal size. Hypertrophy slight.

CASE XVII. Janney, January 26, 1887.—Male, age thirty-four. Cause of death heart failure. Kidneys below normal. Heart weight 24 ounces. Hypertrophy general. Atheroma of aorta and renal.

CASE XVIII. Wilson, March 12, 1887.—Male, age fifty-two. Cause of death phthisis. Kidneys slightly below normal. Heart weight 9 ounces.

CASE XIX. Tyson, April 11, 1887.—Male, age seventy-two. Cause of death heart failure. Kidneys slightly below normal. Heart, old endocarditis. Fatty metamorphosis. Dilatation general.

CASE XX. Wilson, May 17, 1887.—Female, age thirty-eight. Cause of death uræmia. Kidneys, left small, right normal. Cyst. Heart small.

CASE XXI. Bruen, June 10, 1887.—Male, age seventy-four. Cause of death asthenia. Kidneys normal in size. Cyst. Dropsy. Heart large. Valvular disease, aortic and mitral. Hypertrophy general. Atheroma of aorta and coronary, complicated by gastric ulcer.

CASE XXII. Bruen, August 9, 1887.—Male, age fifty-four. Cause of death uræmia. Kidneys equally enlarged. Dropsy. Heart weight 14 ounces. Hypertrophy general. Dilatation general. Atheroma, aorta.

CASE XXIII. Musser, October 24, 1888.—Male, age thirty. Cause of death uræmia. Kidneys enlarged. Heart small.

CASE XXIV. Musser, October 29, 1888.—Male, age fifty-eight. Cause of death uræmia. Kidneys enlarged. Dropsy. Heart weight 20 ounces. Valvular disease, mitral. Hypertrophy general. Fatty metamorphosis. Dilatation left auricle. Atheroma, aorta.

CASE XXV. Musser, October 18, 1888.—Male, age sixty-five. Cause of death emphysema. Kidneys enlarged. Heart small. Valvular disease, aortic and mitral. Atheroma, aorta. Papillary muscles of left ventricle fibroid.

CASE XXVI. Curtin, December 13, 1888.—Female, age thirty-five. Cause of death uræmic convulsions. Kidneys enlarged, right larger. Cysts and dropsy. Heart medium size, mitral stenosis. Hypertrophy slight. Fatty metamorphosis. Dilatation general. History of rheumatism. Renal arteries thick and stiff.

CASE XXVII. Curtin, January 21, 1889.—Male, age sixty-nine. Cause of death alcoholism. Kidneys large. Heart large. Valvular disease, mitral. Hypertrophy general. Atheroma, aorta and coronary. Alcoholism. Chronic gastritis. Emphysema, hydrothorax.

CASE XXVIII. Osler, January 25, 1889.—Female, age seventy-five. Cause of death hydrothorax. Kidneys enlarged, left larger. Cysts and dropsy. Heart small. Valvular disease, mitral. Dilatation right side. Atheroma, aorta (dilated also).

CASE XXIX. Bruen, February 5, 1889.—Male, age forty-three. Cause of death uræmia. Kidneys enlarged. Heart large. Valvular disease, mitral stenosis. Hypertrophy left side. Dilatation left side.

CASE XXX. Bruen, March 3, 1889.—Female, age fifty. Cause of death heart failure. Kidneys about normal. Heart small. Valvular disease, mitral. Fatty metamorphosis. Dilatation general. Emphysema, hydrothorax.

CASE XXXI. Steinbach, June 10, 1889.—Female, age thirty-four. Cause of death embolic pneumonia. Kidneys equally enlarged. Heart normal in size. Valvular disease, aortic and mitral. Died after a surgical operation.

CASE XXXII. Walker, April 19, 1889.—Female, age eighty-seven. Cause of death senility. Kidneys normal size. Cyst and dropsy. Heart medium size. Valvular disease, mitral valve thickened. Dilatation general. Atheroma, aorta and coronaries. Senile change (?).

CASE XXXIII. Tyson, July 13, 1889.—Female, age thirty-eight. Cause of death carcinoma of pylorus. Kidneys normal size. Heart small. Fatty metamorphosis (?). Atheroma, coronary.

CASE XXXIV. Lloyd, August 18, 1889.—Male, age seventy-seven. Cause of death uræmia. Kidneys each 6 ounces. Dropsy. Heart weight 20 ounces. Hypertrophy general. Fatty metamorphosis. Dilatation general. Chronic obliterating pericarditis. Hydrothorax.

CASE XXXV. Curtin, August 12, 1889.—Male, age forty-nine. Cause of death phthisis. Kidneys equally enlarged. Dropsy. Heart large. Hypertrophy general.

RED GRANULAR KIDNEYS (75 CASES).

Appearance of the kidneys the same as in the first series.

CASE I. Wilson, May 24, 1884.—Male, age forty-six. Cause of death uræmia. Cysts not stated. Dropsy none. Heart weight 17 ounces. Valvular disease none. Hypertrophy simple. No other lesions.

CASE II. Bruen, May 28, 1884.—Male, age thirty-two. Cause of death uræmic coma. No cysts. No dropsy. Heart enlarged. Valvular disease none. Hypertrophy left side. Dilatation left ventricle. No other lesion.

CASE III. Walker, October 7, 1884.—Male, age forty-one. Cause of death tubercular peritonitis. No cysts. Ascites. Heart normal. No other lesion.

CASE IV. Walker, October 6, 1884.—Male, age forty-nine. Cause of death uræmia. No cysts. Dropsy present. Heart enlarged. Hypertrophy simple. No other lesion.

CASE V. Tyson, August 28, 1884.—Female, age forty. Cause of death uræmia. No cysts. Dropsy present. Heart weight 28 ounces. Valvular disease, mitral stenosis. Hypertrophy general. Dilatation right ventricle. Atheroma, aorta. Much pericardial effusion.

CASE VI. Bruen, October 6, 1884.—Male, age forty-eight. Cause of death uræmia. Cysts absent. No dropsy. Heart enlarged. Valvular disease, aortic. Hypertrophy left-sided. Dilatation general. Atheroma, aorta.

CASE VII. Neff, October 9, 1884.—Male, age forty-nine. Cause of death œdema of lungs. No cyst. Dropsy present. Heart much enlarged. Valvular disease, aortic stenosis, and regurgitation. Hypertrophy left side. Dilatation left ventricle. Atheroma, aorta. Dilatation of arch of aorta.

CASE VIII. Bruen, November 15, 1884.—Male, age sixty-one. Cause of death uræmia. Cysts present. Dropsy present. Heart much enlarged. Valvular disease none. Hypertrophy general. Left ventricle one inch thick. Dilatation general. Unilateral pleural effusion.

CASE IX. Porter, December 16, 1884.—Male, age twenty-two. Cause of death phthisis. No cysts. No dropsy. Heart small. No other lesion. Kidney somewhat translucent.

CASE X. Curtin, December 18, 1884.—Male, age forty-three. Cause of death uræmia. No cysts. Dropsy present. Heart large. Hypertrophy general. Dilatation both sides. No other lesion. History of syphilis.

CASE XI. Mills, January 15, 1885.—Male, age fifty-two. Cause of death uræmic coma. No cysts. No dropsy. Heart normal. No other lesion.

CASE XII. Wood, February 18, 1885.—Female, age twenty-seven. Cause of death congestion of lungs. No cyst. No dropsy. Heart normal. No other lesion. Epileptic.

CASE XIII. Wood, February 24, 1885.—Male, age seventy-five. Cause of death œdema of lungs. Cysts and dropsy present. Heart large. Valvular disease, mitral. Hypertrophy general. Dilatation general. Atheroma, aorta and coronary. Chronic endocarditis.

CASE XIV. Wilson, April 11, 1885.—Female, age twenty-eight. Cause of death pneumonia. Cysts none. Dropsy present. Heart large. Valvular disease, mitral. Hypertrophy general. Dilatation general. Atheroma, aorta. Pericarditis adhesive and with calcification.

CASE XV. Bruen, May 17, 1885.—Male, age fifty. Cause of death pneumonia. Cysts present Dropsy present. Heart twice normal size. Valvular disease, mitral. Hypertrophy general. Muscles flabby. Dilatation general. Chronic endocarditis.

CASE XVI. Bruen, May 2, 1885.—Male, age forty-seven. Cause of death œdema of lungs. No cysts nor dropsy. Heart normal size. Valvular disease, aortic. Hypertrophy none. Fatty metamorphosis present. Dilatation none. Atheroma, aorta and coronary.

CASE XVII. Bruen, June 9, 1885.—Male, age seventy. Cause of death apoplexy. Cysts present. Dropsy none. Heart normal. Fatty metamorphosis principally on left side. Dilatation general. Atheroma: coronary, cerebral, and aorta. Chronic pleurisy.

CASE XVIII. Curtin, July 12, 1885.—Female, age forty-four. Cause of death asthenia. No cyst. No dropsy. Heart normal size. Valvular disease, slight, mitral. Fatty metamorphosis present. Dilatation.

CASE XIX. Walker, September 12, 1885.—Male, age seventy. Cause of death meningitis. No dropsy. No cysts. Heart enlarged. Valvular disease, mitral. Fatty metamorphosis present. Dilatation general. Atheroma present, especially coronary.

CASE XX. Curtin, October 27, 1885.—Female, age forty. Cause of death exhaustion due to cystitis. No cysts nor dropsy. Heart normal size, Valvular disease none. Hypertrophy none. Fatty metamorphosis present. Muscles flabby and tough. Cystitis and renal calculi.

CASE XXI. Curtin, November 21, 1885.—Male, age seventy-three. Cause of death œdema of lungs. No cysts. Dropsy present. Heart large. Valvular disease, aortic and mitral. Hypertrophy left side. Fatty metamorphosis none. No atheroma. Acute pericarditis. History of syphilis.

CASE XXII. Bruen, June 29, 1886.—Female, age seventy. Cause of death pericarditis. No cyst. No dropsy. Heart normal. Valvular disease, aortic valves thickened. Hypertrophy none. Fatty metamorphosis present. No atheroma. Mediastinal sarcoma. Pericarditis.

CASE XXIII. Neff, August 29, 1886.—Male, age eighty-five. Cause of death uræmia. Cysts present. No dropsy. Heart large. Valvular disease, aortic calcification. Hypertrophy general. Atheroma, aorta.

CASE XXIV. Neff, October 13, 1886.—Female, age fifty-seven. Cause of death uræmia. Cysts none. Dropsy none. Heart normal size. Valvular disease, mitral. Hypertrophy none. Fatty metamorphosis present. Hemorrhagic infarct in kidney.

CASE XXV. Musser, August 31, 1886.—Female, age thirty-six. Cause of death heart failure. No cysts. Dropsy present. Heart weight 17 ounces. Valvular disease, mitral. Hypertrophy general. Atheroma, coronaries.

CASE XXVI. Mills, October 14, 1886.—Female, age seventy-eight. Cause of death sclerosis of brain. Cysts present. No dropsy. Heart enlarged. Valvular disease none. Hypertrophy general.

CASE XXVII. Mills, January 16, 1887.—Female, age sixty-five. Cause of death uræmia. No cysts. No dropsy. Heart normal size. Valvular disease none. Hypertrophy none.

CASE XXVIII. Walker, February 18, 1887.—Male, age fifty-eight. Cause of death uræmia. No cysts. No dropsy. Heart enlarged. Valvular disease none. Hypertrophy left side. Dilatation. right ventricle. Atheroma, aorta.

CASE XXIX. Wilson, February 26, 1887.—Male, age fifty-one. Cause of death œdema of lungs. Cysts present. No dropsy. Heart weight 18 ounces. Valvular disease none. Hypertrophy left side. Dilatation left ventricle. Atheroma, aorta.

CASE XXX. Tyson, April 11, 1887.—Female, age seventy. Cause of death uræmia. No cysts. No dropsy. Heart weight 14 ounces. Valvular disease none. Hypertrophy general. Arterial change, aortic. History of syphilis.

CASE XXXI. Wilson, May 3, 1887.—Male, age fifty-two. Cause of death œdema of brain. No cyst. Dropsy present. Heart normal size. Valvular disease, aortic. Fatty metamorphosis present. Arterial changes, coronary and aorta.

CASE XXXII. Tyson, June 20, 1887.—Female, age fifty. Cause of death apoplexy. No cyst. No dropsy. Heart enlarged. Valvular disease, mitral. Hypertrophy general. Arterial changes, aorta and cerebral. Heart had moderator band.

CASE XXXIII. Ransley, June 27, 1887.—Female, age forty-one. Cause of death heart failure. Cysts present. Dropsy absent. Heart small. Valvular disease, mitral. Fatty metamorphosis present. Dilatation present.

CASE XXXIV. Tyson, August 20, 1887.—Male, age sixty-five. Cause of death uræmia. Cysts present. Dropsy present. Heart small. Valvular disease, aortic and mitral. Fatty metamorphosis present. Dilatation present. Arterial changes, aorta and coronary.

CASE XXXV. Mills, September 1, 1887.—Female, age ninety-six. Cause of death senility. Cysts present. Dropsy absent. Heart small. Valvular disease, aortic and mitral. Fatty metamorphosis present. Arterial change, aorta.

CASE XXXVI. Dercum, October 22, 1887.—Male, age eighty-two. Cause of death uræmia. Cysts absent. Dropsy absent. Heart normal size. Fatty metamorphosis present. Arterial change, aorta and coronary.

CASE XXXVII. Dercum, November 19, 1887.—Male, age fifty-four. Cause of death œdema of brain. Cysts and dropsy both absent. Heart enlarged. Valvular disease, mitral. Hypertrophy left side.

CASE XXXVIII. Dercum, November 27, 1887.—Female, age eighty. Cause of death œdema of brain. Cysts absent. Dropsy present. Heart enlarged. Valvular disease, mitral and aortic. Hypertrophy general. Arterial changes, aorta. Aneurism of abdominal aorta.

CASE XXXIX. Parish, December 25, 1887.—Female, age forty. Death sudden. Cysts and dropsy both absent. Heart small. Fatty metamorphosis present. Dilatation present. History of syphilis.

CASE XL. Osler, January 25, 1888.—Female, age fifty-six. Cause of death uræmia. Cysts present. Dropsy absent. Heart large. Valvular disease, mitral. Hypertrophy left side. Pleural effusion.

CASE XLI. Henry, March 30, 1888.—Female, age seventy. Cause of death heart failure. Cysts none. Dropsy none. Heart weight 18 ounces. Valvular disease, aortic and mitral. Hypertrophy general. Arterial changes, aorta and coronary. Patulous foramen ovale and endocarditis.

CASE XLII. Walker, April 28, 1888.—Male, age sixty-eight. Death sudden. Cysts present. Dropsy present. Heart weight 31 ounces. Valvular disease, aortic. Hypertrophy left side one and a quarter inch in front. Chronic adhesive pericarditis.

CASE XLIII. Walker, May 4, 1888.—Female, age sixty-eight. Cause of death uræmia. Cysts absent. Dropsy present. Heart weight 14 ounces. Hypertrophy right side. Arterial change, aorta and coronary.

CASE XLIV. Dercum, August 12, 1888.—Male, age fifty-two. Cause of death senile gangrene. Cysts absent. Dropsy absent. Heart normal size. Valvular disease, aortic and mitral. Hypertrophy left side. Arterial changes, aortic and coronary. Heart firmly contracted.

CASE XLV. Deaver, August 21, 1888.—Female, age forty-one. Cause of death uræmia. Cysts none. Dropsy none. Heart normal size.

CASE XLVI. Musser, September 21, 1888.—Female, age forty-six. Cause of death uræmia. Cysts present. Dropsy absent. Heart normal size. Valvular disease, mitral. Hypertrophy slight and general. Arterial changes, coronary.

CASE XLVII. Osler, September 10, 1888.—Male, age forty-seven. Cause of death uræmia. No cysts nor dropsy. Heart large. Hypertrophy present, right ventricle larger than left. Arterial changes, aorta and coronary. Small renal arteries greatly enlarged.

CASE XLVIII. Mills, October 9, 1888.—Male, age sixty. Cause of death uræmia. Cysts present. Dropsy absent. Heart large. Valvular disease, mitral and aortic. Hypertrophy left side. Dilatation left side.

CASE XLIX. Dercum, October 12, 1888.—Male, sixty-three. Cause of death pneumonia or uræmia. Cysts present in both. Dropsy absent. Heart normal. Valvular disease, aortic, chronic. Fatty metamorphosis present. Atheroma, aorta. Pneumonia.

CASE L. Musser, October, 12, 1888.—Female, age ninety-one. Cause of death abdominal aneurism. Cysts present in both kidneys. Dropsy absent. Heart large. Valvular disease, aortic, chronic. Hypertrophy left side. Atheroma, aortic and general. Large abdominal aneurism. Renal arteries also atheromatous, papillary muscles fibroid change.

CASE LI. Mills, October 15, 1888.—Male, age sixty-five. Cause of death pachymeningitis hemorrhagica. Cyst present in both kidneys. Dropsy absent. Heart large. Valvular disease, mitral, chronic. Hypertrophy general. Atheroma, aorta and coronary.

CASE LII. Bruen, November 20, 1888.—Male, age seventy-eight. Cause of death pulmonary œdema. Cysts present. Dropsy present. Heart normal size. Valvular disease, aortic regurgitation. Atheroma: aorta, internal carotid, basilar, and coronary. Aortic valves fenestrated and hydronephrosis.

CASE LIII. Dercum, October, 20, 1888.—Female, age seventy-six. Cause of death apoplexy. No cysts. No dropsy. Heart small. Valvular disease, aortic. Fatty metamorphosis present. Atheroma, aorta and arteries of brain.

CASE LIV. Curtin, October 31, 1888.—Female, age sixty-five. Cause of death pulmonary œdema. Cysts present. Dropsy absent. Heart enlarged. Valvular disease, mitral. Hypertrophy left side. Dilatation right ventricle. Atheroma, aorta.

CASE LV. Musser, November 21, 1888.—Female, age sixty-eight. Cause of death uræmia. Cysts and dropsy both absent. Heart large. Valvular disease, mitral. Hypertrophy left side. Atheroma, aorta and coronary.

CASE LVI. Dercum, December 1, 1888.—Female, age seventy-three. Cause of death pneumonia. Cysts present. Dropsy present. Heart large. Hypertrophy left side. Atheroma, aorta and cerebral arteries. Cirrhosis of liver.

CASE LVII. Dercum, December 30, 1888.—Male, age fifty-six. Cause of death uræmic convulsion. Cysts present. Dropsy present. Heart large. Valvular disease, mitral. Hypertrophy general. Fatty metamorphosis present. Dilatation general. Atheroma, aorta and cerebral.

CASE LVIII. Mills, December 18, 1886.—Female, age seventy-two. Cause of death meningitis. Cyst absent. Dropsy absent. Heart normal size. Valvular disease, aortic and mitral. Hypertrophy none. Fatty metamorphosis. Dilatation marked.

CASE LIX. Musser, December 29, 1886.—Female, age fifty-five. Cause of death pneumonia and uræmia. Cyst and dropsy absent. Heart weight 11 ounces. Valvular disease none. Hypertrophy general. Fatty metamorphosis none. Dilatation right ventricle. Atheroma, aorta and coronaries.

CASE LX. Neff, December 30, 1886.—Female, age thirty-five, highly anæmic. Cause of death uræmia. No cysts. No dropsy. Heart normal size. No other lesion. History of malaria.

CASE LXI. Henry, February 20, 1889.—Male, age forty-eight. Cause of death uræmia and pneumonia. Heart weight 10 ounces. Valvular disease and dropsy none. Hypertrophy slight.

CASE LXII. Montgomery, March 5, 1889.—Female, age sixty. Cause of death uræmia. Heart large. Valvular disease none. Hypertrophy left-sided. Dilatation right-sided. Ovariotomy.

CASE LXIII. Walker, March 29, 1889.—Female, age ninety. Cause of death heart failure. Many cysts. Dropsy present. Heart large. Valvular disease, aortic and mitral. Fatty metamorphosis present. Dilatation general. Atheroma, aorta and coronaries.

CASE LXIV. Tyson, April 19, 1889.—Male, age sixty. Cause of death pleural effusion. Dropsy present. Heart normal size. Displaced by right-side pleural effusion.

CASE LXV. Walker, April 18, 1889.—Female, age seventy-nine. Cause of death phthisis. Heart normal. Valvular disease, aortic. Hypertrophy slight. Dilatation slight. Heart and kidney changes may be senile.

CASE LXVI. Wilson, May 3, 1889.—Male, age sixty-three. Cause of death heart failure. Cysts present. Dropsy absent. Heart weight 20 ounces. Valvular disease, aortic. Hypertrophy left-sided one inch. Fatty metamorphosis none. Dilatation general. Atheroma, aorta and cerebral.

CASE LXVII. Henry, June 11, 1889.—Male, seventy-six. Cause of death emphysema. Dropsy present. Heart weight 18 ounces. Valvular disease, slight thickening. Hypertrophy general.

CASE LXVIII. Henry, June 15, 1889.—Female, age eighty-four. Cause of death senility. Cysts present. Dropsy absent Heart weight 9 ounces. Valvular disease none. Hypertrophy slight. Atheroma, aorta and coronaries.

CASE LXIX. Lloyd, June 26, 1889.—Male, age sixty-nine. Death sudden. Heart weight 24 ounces. Valvular disease none. Hypertrophy general. Atheroma, basilar arteries.

CASE LXX. Henry, July 11, 1889.—Male, age fifty-five. Cause of death uræmia. Heart very large. Valvular disease none. Hypertrophy left side.

CASE LXXI. Walker, July 15, 1889.—Female, age seventy-one. Cause of death phthisis. Cysts present. Heart small. Valvular disease, aortic. Atheroma, coronaries.

CASE LXXII. Walker, July 17, 1889.—Female, age eighty. Cause of death uræmia. Cysts none. Dropsy present. Heart weight 22 ounces. Valvular disease, mitral insufficiency. Hypertrophy general, left ventricular one and a quarter inch, right three-quarters of an inch. Atheroma none.

CASE LXXIII. Lloyd, July 22, 1889.—Male, age forty-nine. Cause of death apoplexy. Heart weight 20 ounces. Valvular disease, aortic. Hypertrophy left side. Dilatation left side.

CASE LXXIV. Dercum, July 27, 1889.—Male, age forty-nine. Cause of death meningitis. Heart weight 11 ounces. Valvular disease, mitral. Hypertrophy slight. Atheroma, root of aorta. Contraction of kidney, slight, cyanotic.

CASE LXXV. Dercum, August 1, 1889.—Female, age fifty-three. Cause of death cerebral apoplexy. Heart normal size. Valvular disease, mitral, slight. Atheroma: aorta, coronaries, and cerebral.

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